

Practical Computing

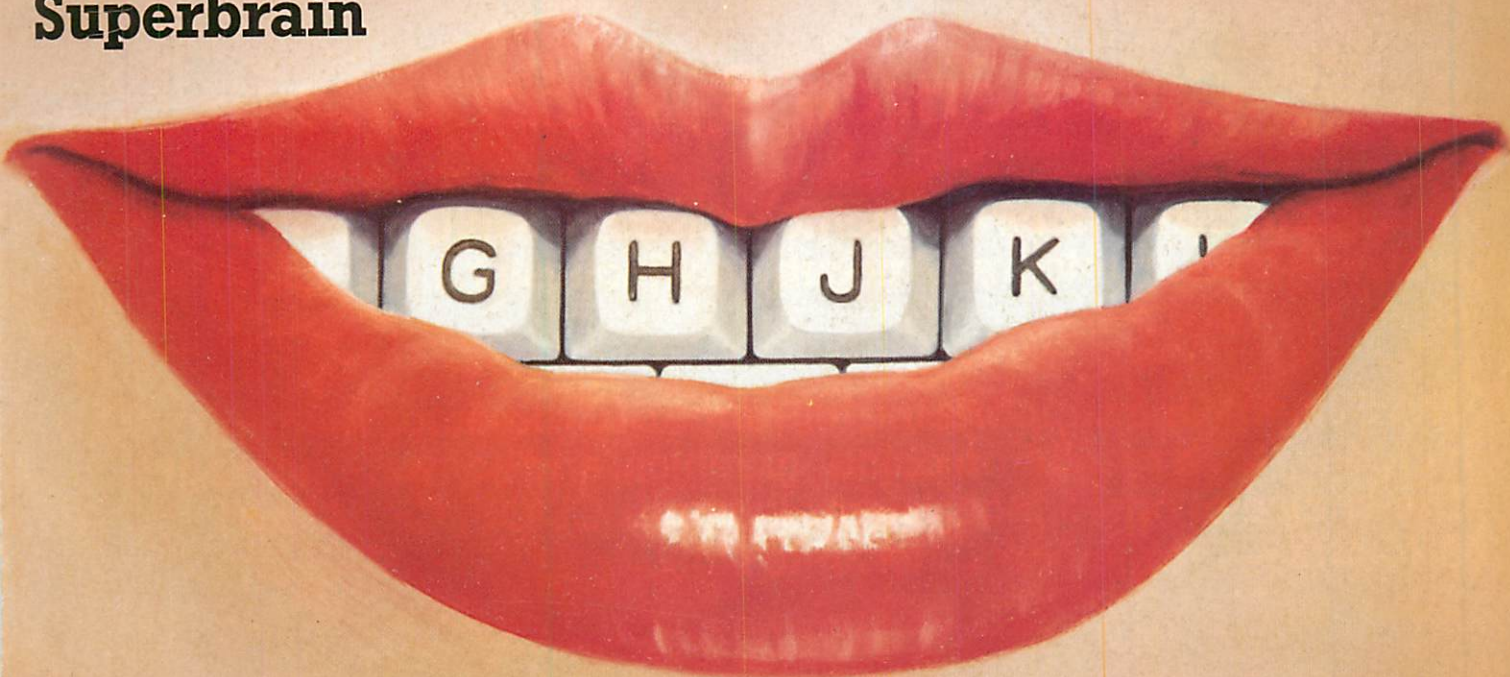
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June 1982

Volume 5 Issue 6

Natural language

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Natural language — page 70

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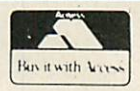
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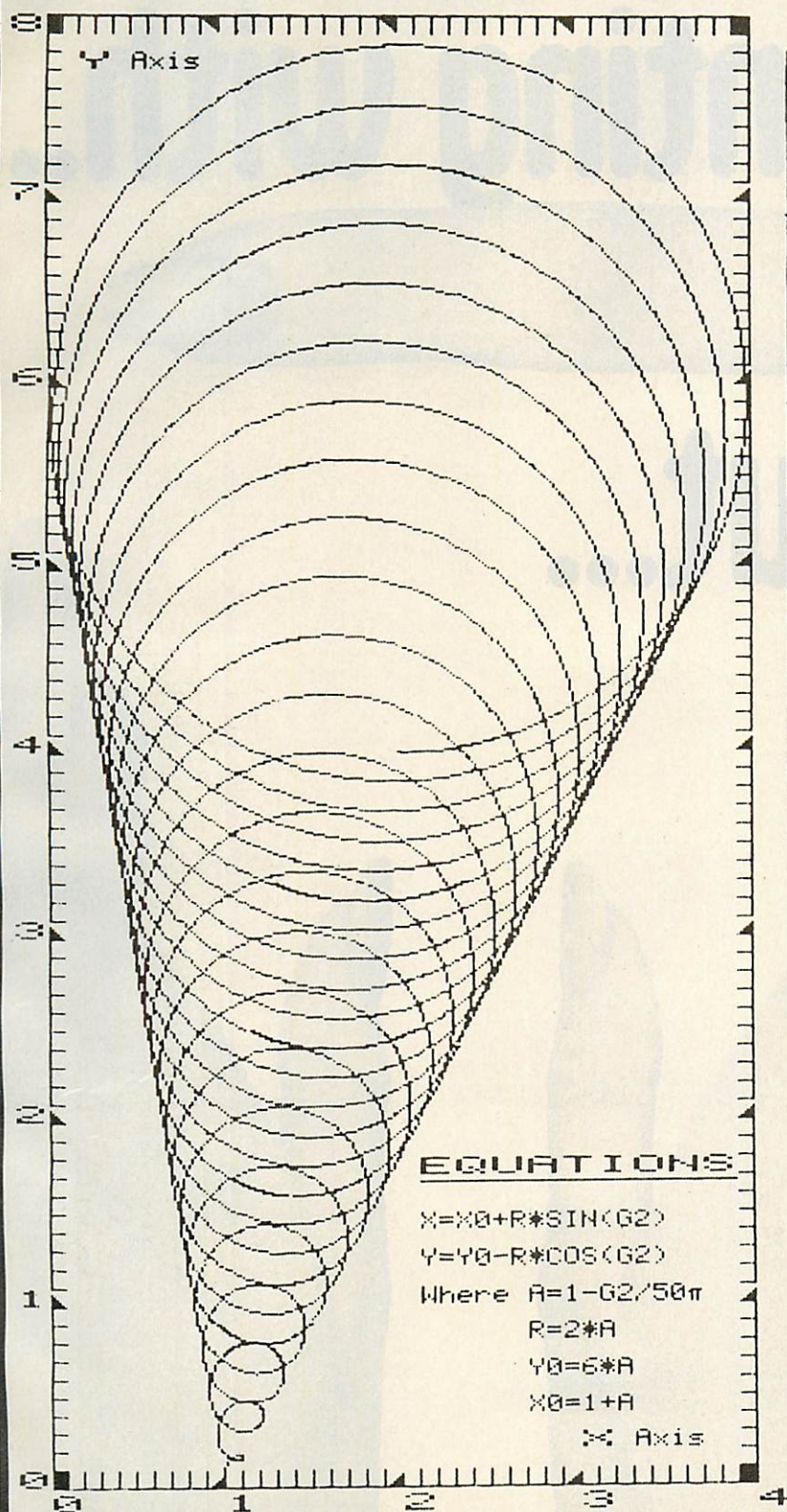
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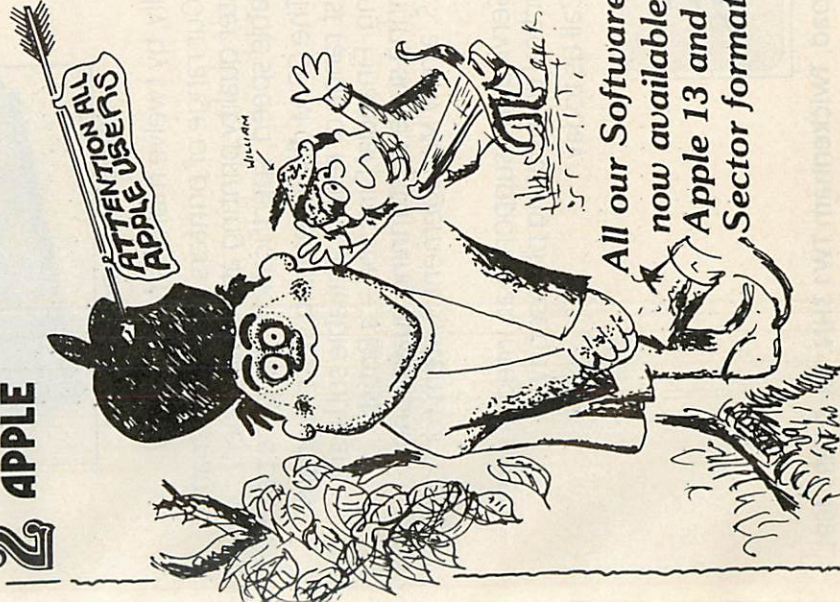
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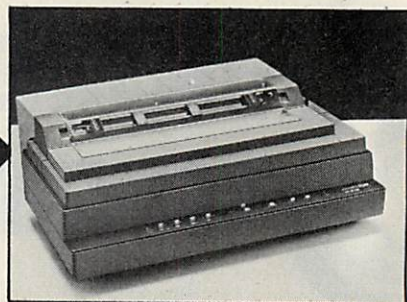


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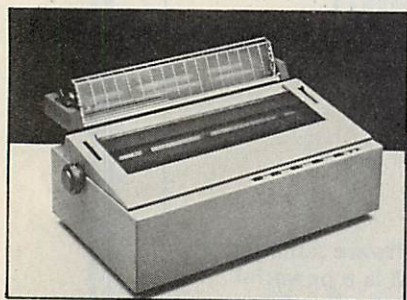
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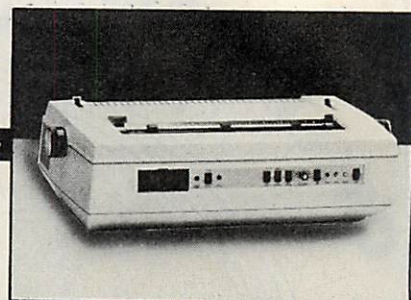
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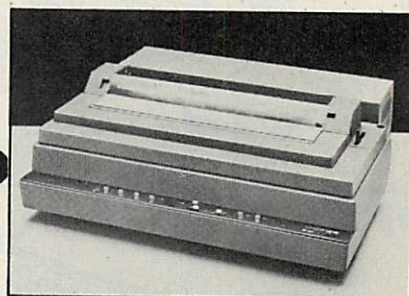
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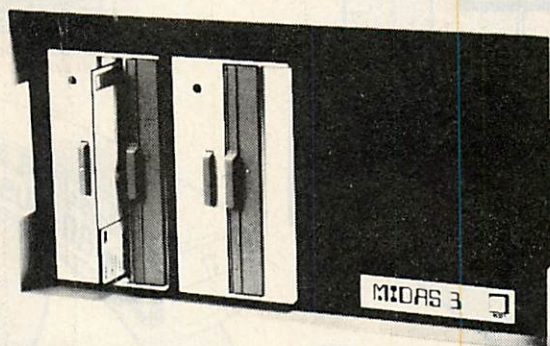
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DRIVE UNIT



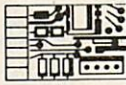
GM 809 FDC

The GM809 floppy disk controller card can support up to four disk drives in either single or double density modes. The card uses the Western Digital 1797 controller and has variable write precompensation and phase locked loop data recovery circuitry.

GM 815 Drive unit

The GM815 floppy disk housing contains one or two 5 1/4" double density, double sided Pertec FD 250 drives. This gives a storage capacity of 350K per drive. Power for the drives is provided by an integral supply unit.

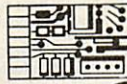
The GM802 RAM board provides a full 64K of dynamic memory. The 80 BUS RAMDIS signal is fully supported so that any EPROM in the system is given priority over the RAM, preventing any possibility of bus contention. Page Mode is also supported by the card which, with the appropriate software, allows up to four memory boards to be used in a system.



GM 802
RAM

RP/M software is available on tape and includes Editor/Assembler; Text Editor/Formatter; Disassembler/Debugger; Pascal and Comal-80. These packages can also be run under CP/M.

The GM803 Eprom Board will accept up to 16 2708 or 2716 Eprom devices. This allows the addition of up to 32K of firmware to the system. The board supports the Page Mode system and consequently need not occupy any memory space when not in use.



GM 803
EPROM BOARD

A number of manufacturers are busy working on additional 80-BUS boards which will progressively increase the potential of your MultiBoard system.

MEN AT WORK

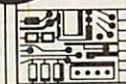
80 BUS compatible prototyping boards are available from both Vero and Winchester Technology. These allow the user to easily add a card of their own design to the system.



PROTO-TYPING BOARDS

GM 816
I/O BOARD

The Gemini I/O board provides a unique solution for interfacing to "the real world". The board contains 3 PIO's, a CTC and a real time clock with battery back up. "Daughter" boards may also be added and these include A-D, D-A, opto-coupling and serial interface boards.

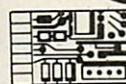


GM 808
EPROM PROGRAMMER



The GM808 Eprom programmer connects to the PIO on the CPU card and allows the user to program 2708 or 2716 type Eproms.

AM 819
SPEECH BOARD



The Arlon Microelectronics speech board utilises the National Semiconductor Digitaltalker chip set. This gives a vocabulary of over 140 words and sub sounds. Output is from an on-board speaker.

AM 820
LIGHT PEN



This low cost light pen can be used with the GM812 IVC for many applications, including answer selection, editing, menu selection and movement of displayed data blocks.

EV 814
IEEE 488



The EVC IEEE 488 Controller card has been designed to fully implement all IEEE 488 interface functions. This card gives the user a very versatile method of controlling any equipment fitted with a standard IEEE 488 or GPIB interface at minimal cost.

AUTO-EXCHANGE
All your RP/M software automatically transferred to CP/M



FILL-UP WITH SOFTWARE



A CP/M 2.2 package is available with the GM 809 card and Pertec drives. On-screen editing auto single/double density selection and parallel or serial printers are supported. Running under CP/M is a wide range of utilities, application software and languages.

GEMINI MULTIBOARDS - BUY THEM AT YOUR LOCAL MICROVALUE DEALER

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Find all patients who have either girls or women younger than 23 years old, and who live in London at socio-economic grade higher than 3; do not smoke; have more than 3 children, are currently at work and where treatment failed to effect a cure in under 6 days. When you find such persons then print a list showing their age, marital status, income, and frequency of illness in the past 2 years.

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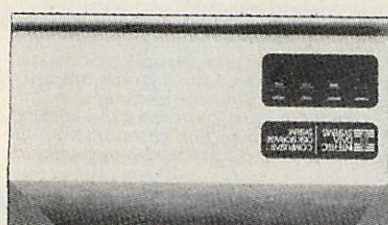
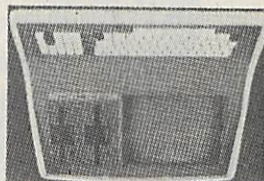
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But the real beauty of the Computar is its "shared logic" design concept. Each user station contains its own distinct microprocessor and RAM. The result is lightning fast program execution. Even when all 16 users are on-line. Even when all are performing different tasks! A special multiplexor circuit in the Computar ties all external users together so that no single user ever need wait on another. An incredible exciting concept!

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Computar user stations can be configured in a countless number of ways. A series of three intelligent-type terminals are offered. Each is a perfect cosmetic and electrical match to the system. The Computar 10 - a 32K programmable RAM-based terminal (expandable to 64K) is just right if your requirement is a data entry or inquiry/response application. And, if your terminal needs are more sophisticated, select either our Computar 20 or Computar 40 as user stations. Both units offer dual disk storage in addition to the disk system in the Computar. The Model 20 features 32K of RAM (expandable to 64K) and 350K of disk storage. But, most importantly, no matter what your investment in hardware, the possibility of obsolescence or incompatibility is completely eliminated since user stations can be configured in any fashion you like - whenever you want.

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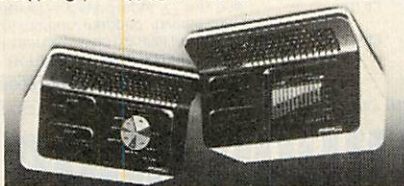
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02	= ST/OC CONTROL
03	= A/C RECEIVABLES
04	= SALES LEADER
05	= P/C LEADER
06	= PURCHASE LEDGERS
07	= BANK UPDATE
08	= USER DATABASE AREA
09	= INVOICE CREATION
10	= ORDER FILES
11	= 30/60/90 DAY AGE ANALYSIS
12	= ARITHMETIC SECTION
13	= PRINT CUSTOMER STATEMENTS
14	= PRINT SUPPLIER STATEMENTS
15	= PRINT AGENT STATEMENTS
16	= PRINT TAX STATEMENTS
17	= RUN SEPARATE PROGRAMS
18	= CHANGE VOCABULARY
19	= NOMINAL ANALYSIS
20	= AGED DEBTOR ANALYSIS
21	= DISK DIRECTORIES
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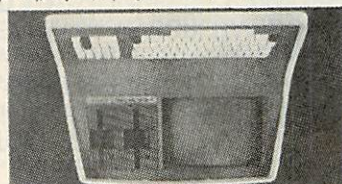
The ADVENTAGE contains a 4MHz Z80A® CPU with 64Kb of 200 nsec Dynamic RAM (with parity) for program storage, a separate 200K 200 nsec RAM to drive the bit-mapped display, a 2Kb bootstrap PROM and an auxiliary Intel 8035 micro-processor to control the keyboard and floppy disks. or as a bit-mapped display (240 x 640 pixels), where each pixel is controlled by one bit in the 200K display RAM. The two integrated 5 1/4 inch floppy disks are double-density, providing storage of 500Kb per drive for a total of 200K. The n-key rollover Selectric-style keyboard contains 49 standard alphanumeric keys, 9 symbol or control keys, a 14 key numeric/cursor control pad and 15 user programmable function keys.



Superdri™ users get exceptional performance for just a fraction of what they'd expect to pay. Standard Superdri™ features include: two double density mini-diskettes with 500K bytes of disk storage, 32K of RAM memory (expandable to 64K) to handle even the most sophisticated programs, a CP/M™ Disk Operating System with a high powered text editor, assembler, debugger and a disk formatter. As with Superdri's S-100 bus adaptor, you can add all the programming power you will ever need... almost any type of S-100 compatible bus accessory.

Superdri's CP/M operating system boasts an overwhelming amount of available software in BASIC, FORTRAN, COBOL, and APL. Whatever your application, Superdri's General Ledger, Accounts Receivable, Payroll, Inventory, Word Processing, and Spreadsheets are tops in its class. And the Superdri™ system is designed to perform as fast as a double density system to render more than 700K bytes of disk storage and a full 64K of RAM. All standard!

Whatever model you choose, you'll appreciate the carefully attention given to every engineering detail. A full ASCII keyboard with numeric pad and user-programmable function keys. A non-alpha, specially-touched, 12-inch CRT for sharp images everywhere on the screen. 1.780 microprocessors to ensure efficient data transfer to auxiliary peripheral devices. Dual universal RS-232C communications ports for serial data transmission. And, a single board design to make servicing a snap!



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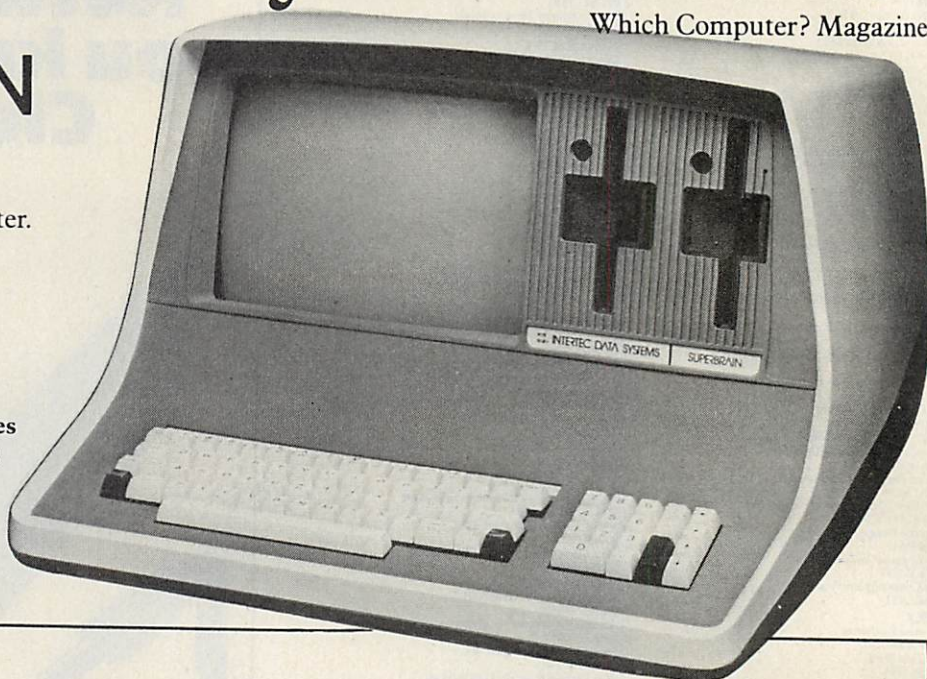
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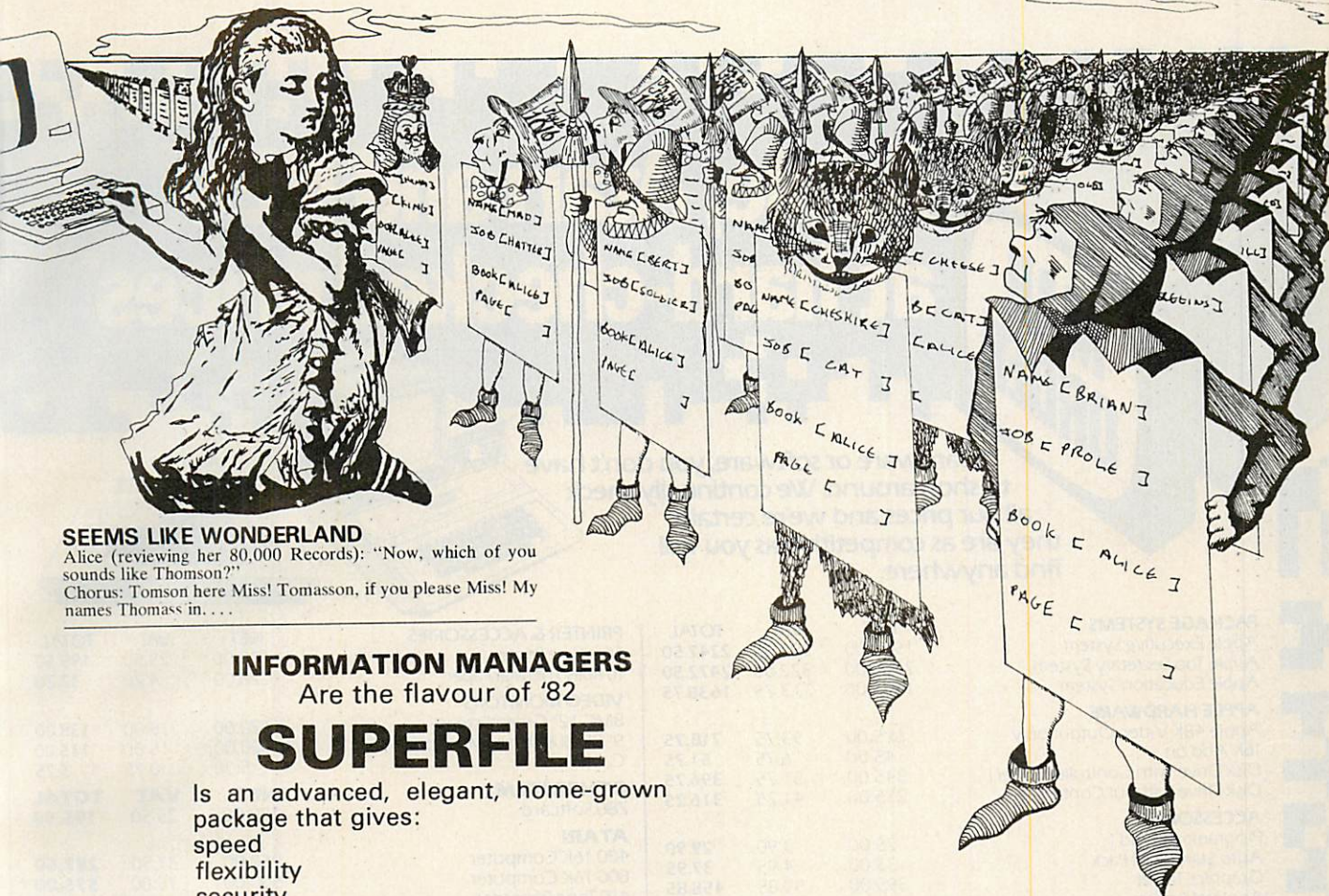
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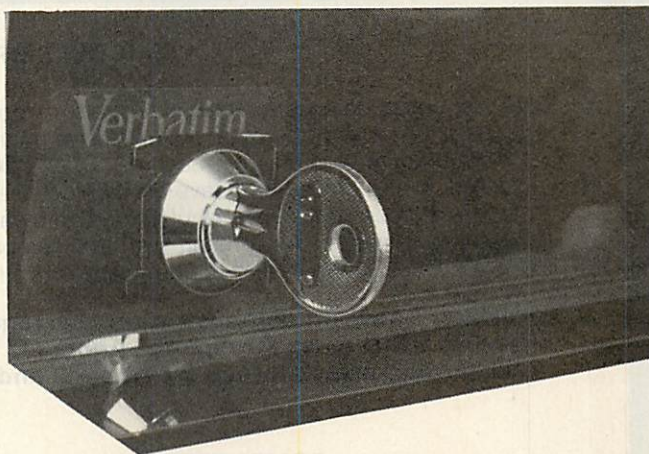
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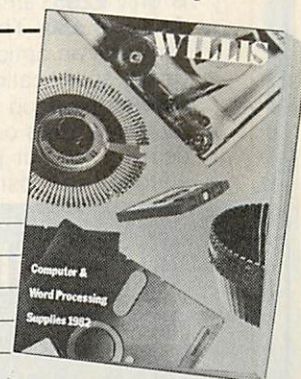
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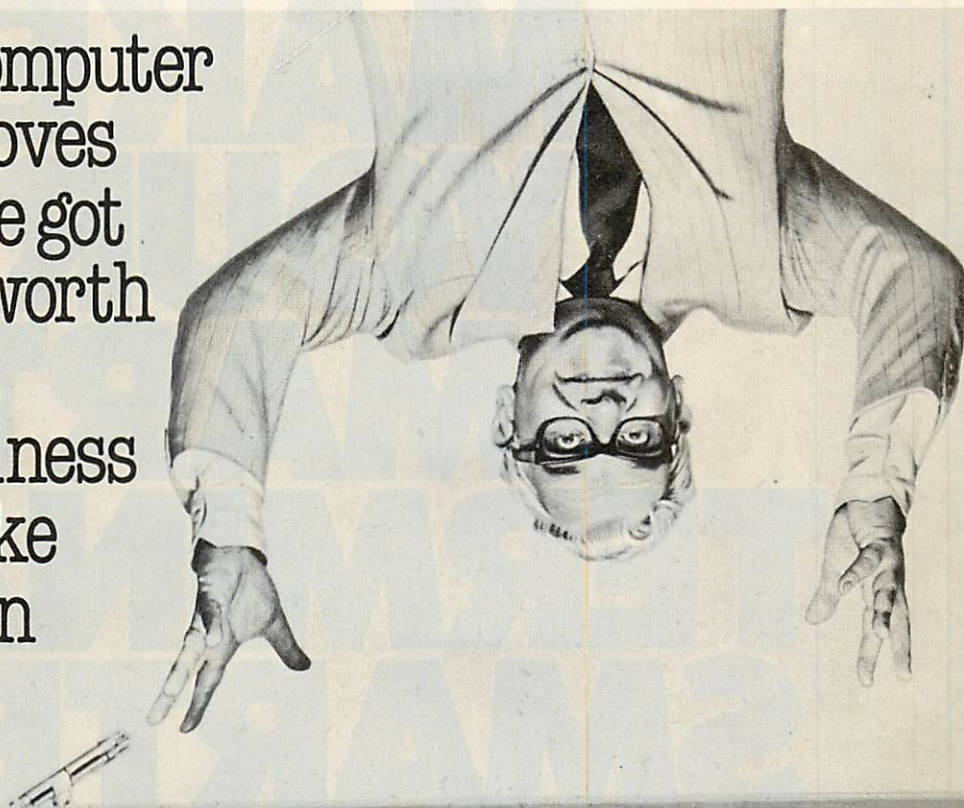
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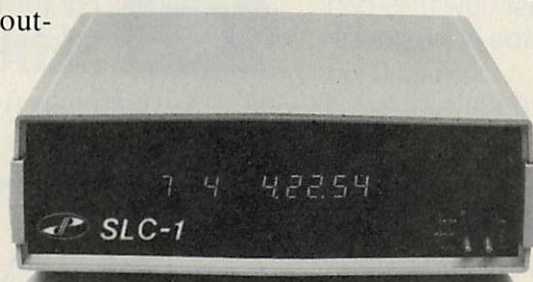
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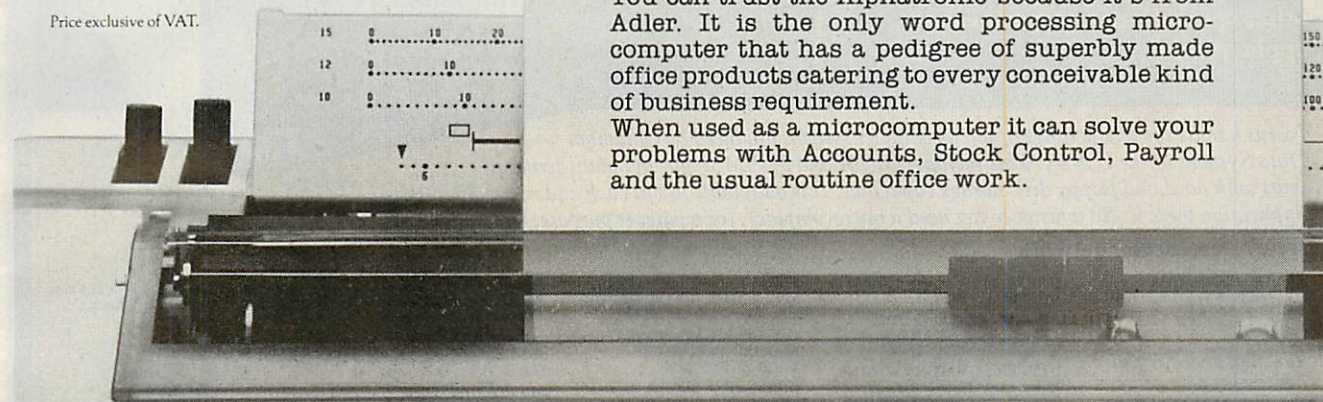
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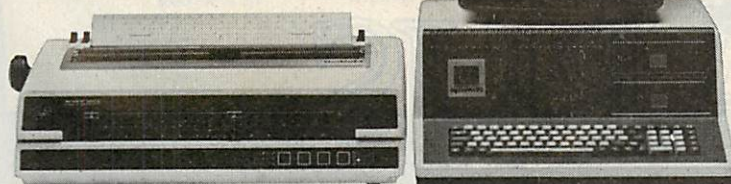
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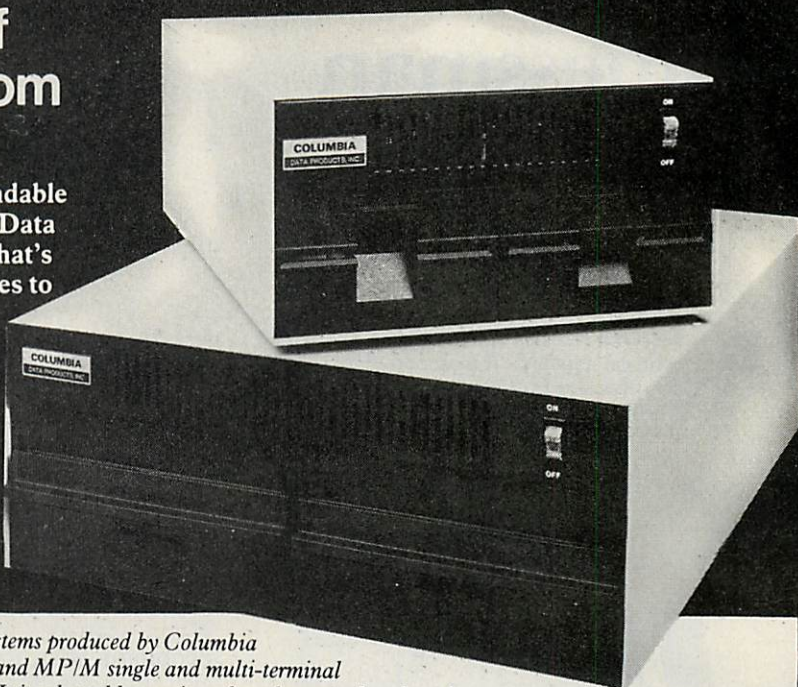
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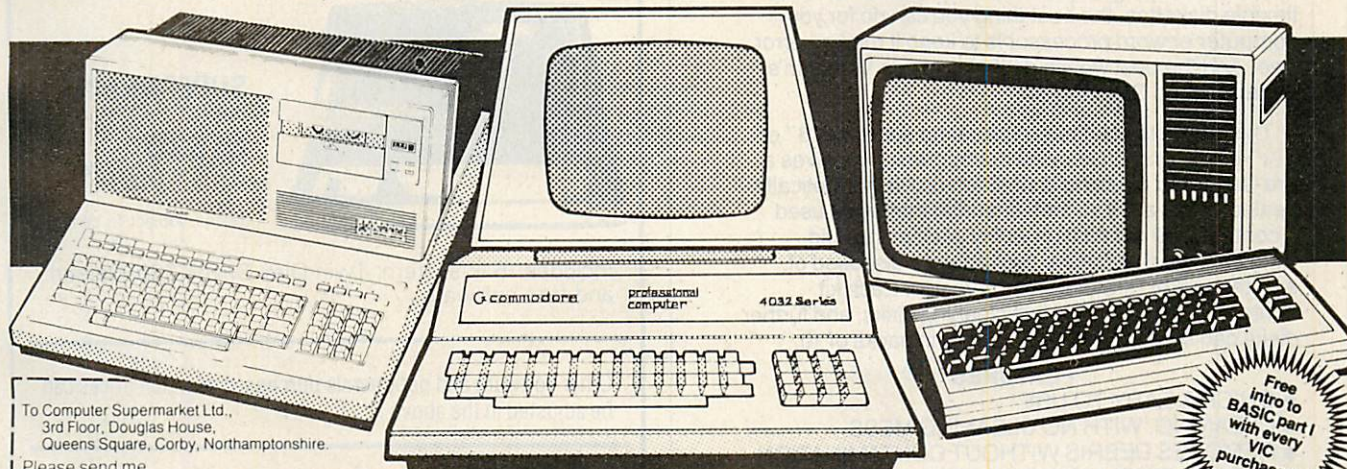
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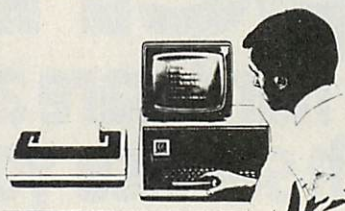
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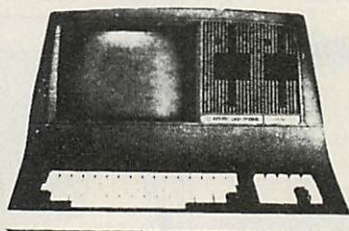
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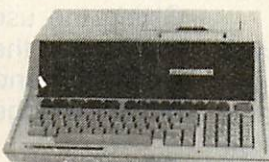


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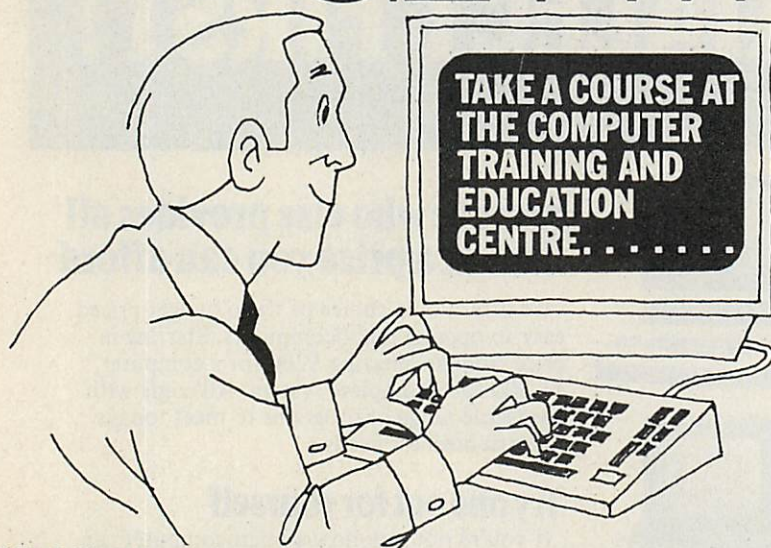
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A question of band-width

THE ONLY successful economic activities in Britain nowadays seem to be telecoms and company liquidation — the impoverished talking to the broke. Out of that, in recent weeks, we received two pieces of news: one bad and one, possibly, very good.

The bad news, which so far is only a rumour, is that Prestel will fold its tents and steal quietly away into a less public line of business. Some of us can remember, three years ago, hearing about an early demonstration of Prestel to the Directors of IPC, the company that publishes *Practical Computing*. One of them was reported to have said, on being shown the electronic marvel: "It will never catch on". How we all laughed! How we all scorned this bone-headed example of big-business obscurantism! And how very right he was.

When Prestel was first mooted it was quite clearly a Good Thing. One could not exactly explain why it was a Good Thing without waving one's hands about, which is to say that its goodness was so deeply diffused throughout the whole structure of the invention that it did not, and could not, appear at any particular, graspable point. In retrospect, that hand-waving might be seen as a bad sign.

In competition with paper communication Prestel should allow a communication-hungry public to find out anything in very little time. If the 8.50 to Edinburgh is going to be 10 minutes late setting out this morning, the departure time in the Prestel timetable should say so. If there are 20 standby seats on the 1600 flight to San Francisco that should appear. If you want a 1932 Le Mans replica Bugatti, one old-lady owner, Prestel should lead you to her.

In practice it has not been like that. Because people do not rely on Prestel timetables you have no confidence that they are right. You tend to ring up to check, just as you always did. One of our contributors, who has spent three years intimately connected with the beast, confesses that he has only twice in that time used Prestel to find out information that he could have acquired no other way.

Prestel came into a world which had elaborate and effective ways of disseminating information, even if, as seen by the electronic whizz-kids, these methods were so archaic that they could not work. In practice, people knew how to use them and how much to trust them, and the channels of distribution had become woven over the course of time into a dense and satisfactory mat. There is, after all, no reason why you should automatically turn to the back page of *The Guardian* to see what yesterday's temperature was in New York, but some of us do.

A hundred years and more of newspaper publishing have arranged things so that this number is read in New York and transmitted to your breakfast table to arrive in just the place where you expect it. Dozens of people and millions of pounds worth of equipment must be involved, but no one gives it a second thought. How would you find out through Prestel?

Prestel offers a jungle that is very much like the game of Adventure. You have no idea what is hidden in those caves, how to find them and what they will do to you when you do. There is a horrible, groping-in-the-dark feel about using Prestel that compares very badly with printed information products. When you pick up *Practical Computing* you can see exactly what is there. You skim through, this way and that, and build up a picture of the issue in your mind. That ad looks interesting, I'll come back to it. Oh no, not that article again! Skip it.

The human mind has a need to comprehend, even if very vaguely, what it is dealing with. And it is a need Prestel does

not satisfy. You only learn about the database by examining it minutely, page by page. It keeps changing, so what you have learned does not persist. It is like the blind men feeling an elephant.

The same difficulty stymies many people when they try to get to grips with micros. You cannot see what is inside the thing. After some months of agonising experiment you learn to "see in the dark", to build up a picture of the internal structures by their actions. The only other job like it is that of the driver who often has to work in such muddy waters that a sense of sight is useless. You must learn to build up a picture of the surroundings by touch, just as though you were blind. Not many people are good at this, and fewer still enjoy having to do it.

The second supposed advantage of Prestel is that it does away with the wasteful and expensive process of cutting down trees, boiling them, marking them and trucking them round the country. It is a process that should not have to happen, but it does and it works fine. Anyone who plans to replace it has to offer very substantial advantages. Prestel does not.

What has been the drawback to Prestel? With hindsight — such a convenient position to pontificate from — it is a question of band-width. The human mind is built to process some 10Mbits of visual information each second; 0.5Mbits of sound, perhaps another 0.5Mbits of touch taste, temperature and internal sensations: a total of around 11Mbits each second. Without it the brain starves.

Unfortunately, all communications technology is narrow-band stuff. You can read about 200 words a minute, so a book has a bandwidth of 160 bits per second or about the same as Morse code. The telephone is limited to about 5Mbits per second, TV provides about 2Mbits per second and wide-screen 70mm. film about 6Mbits per second. You only have to compare the popularity of TV with books to see whether people at large prefer high bandwidth to narrow. Compare the number of people who write voluminous letters to those who send a colour photo.

It takes many years of education to train a person's mind to peer through the narrow-bandwidth keyholes. A minute fraction of the population has been taught properly to read: 98 percent of Americans cannot understand a sentence with more than 30 words, and there is no reason to think the British are any better. The progress of computing is a struggle to train people to compress their minds. The dedicated few may worry their heads about recursive languages and database management, but what the people like is pictures.

Having worked through this rather miserable preamble, we can now come to the good news: the Government's vigorous intention to rewire the country with optical fibre. No doubt there will be wrangles about standards and finance, but the upshot of it all will be long-distance personal information links capable of satisfying the brain's demand for bandwidth. When that can be fulfilled, you can expect the wired society to take off, because it will be capable of supplying what the mass market wants. We really will be able to have two-way mind travel. One would be surprised if this network did not make profound changes in the way people work, shop, go on holiday and go courting.

To go with broad-band data links we need cheap domestic computers, capable of powerful picture manipulation in real-time. In the light of this, the 64-bit micro with 1Mbit of RAM on a chip is not an esoteric engineering toy, but a consumer item that Woolworth's will want to stock before the end of the decade. 

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Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback—it is your chance to keep in touch.

Neat layout

MY PROGRAM Neat Layout, Pet Corner, February, contains an error in listing 1. Line 20 should read:

```
20 AL=LEN (A$):IFAL = <WCTHENAS =
  AS+LEFT$(SP$,WC-AL+1):GOTO40
```

Bruce Humphries,
Epsom,
Surrey.

16-bit CP/M

I AM A KEEN ADVOCATE of the new 16-bit CP/M computers, believing this to offer sufficient advantages over the well-known eight-bit CP/M to be a serious alternative. However, the advertisement for the ACT Sirius in the March *Practical Computing* contains two statements which could seriously mislead:

- "It's launched with more software than anything before it."
- "And the ACT Sirius 1 can run any software written for CP/M — that means hundreds of specialised packages."

The CP/M Users' Group has received reports that the problem with 16-bit CP/M is the lack of software, and this is not surprising since CP/M-86 has not been available for long. This is not a reflection on either the performance of CP/M or the 16-bit computers, but simply that application software cannot be written until CP/M-86 computers become available to the software houses.

CP/M-86 is the implementation of CP/M for the Intel family of 16-bit processors known as the 8086 and 8088, which have a completely different machine-instruction set to the 8080 or Z-80 processors used by CP/M-80. Software written in 8080 instructions cannot be run without modification under CP/M-86. As the majority of CP/M software is written for the eight-bit CP/M, the claim that it is launched with more software cannot be substantiated. Indeed, there is currently little software written for CP/M-86, though I am sure this will change very shortly with the availability of 16-bit computers such as Sirius.

Perhaps these two statements appear in the advertisement because of a misunderstanding of the compatibility between the eight-bit 8080 and the 16-bit 8086. Software for the 8080 can run on the 8086, but the crucial factor is that the 8080 assembly-language operation code or mnemonics have to be converted into 8086 code. For each 8080 mnemonic there is an equivalent 8086 mnemonic or set of mnemonics.

Both Intel and Digital Research provide a conversion utility which will read

8080 assembly-language source code and produce an equivalent 8086 assembly-language source code. This code is then assembled using the 16-bit assembler. These converters make it simple for a software house to painlessly convert eight-bit software to 16-bit software, but there are two drawbacks:

- The program produced is likely to be larger.
- The program is likely to run slower on the 16-bit than the eight-bit.

A third limitation of the conversion is that the program space is limited to the eight-bit 64K. The space available for a user's Basic program can actually be less on the 16-bit than on the eight-bit, and can run slower on the 16-bit if the Basic interpreter is only a conversion from the eight-bit.

Any purchaser of 16-bit software should therefore ask if the software is a conversion of the eight-bit or whether it has been rewritten to make full use of the 16-bit features.

David Powys-Lybbe,
CP/M Users Group (U.K.),
London EC2.

Patsy Pokes

PATSY, the Programmer Aptitude Testing System in the March issue turned out to be a real test after all. I have found errors in nine of the Poke statements, which should read.

Line		
10110	Poke 16639, 178	Poke 16640, 69
10210		61 73
10310		10 76
10410		130 79
10510		245 81
10610		109 84
10710		126 88
10810		47 92
10910		73 95

Ted Swann,
Middle Assendon,
Oxfordshire.

Course programming

I READ with interest, and mounting amazement, Michael Smith's article on Programmer Aptitude Testing in the March issue of *Practical Computing*. The article sets out a method and program for testing the logical and analytical skills of an applicant for computer programming using what is effectively a binary-logic test.

It became apparent that the best score could be achieved by pressing the required buttons 4, 5 and 6 using simple combinational selection without any analysis of the problem at all. This will produce a working solution in a maxi-

mum of 7 steps, excluding the option of no switches pressed, for each of the night and day states. On average the solution will take only 3.5 steps. The possible combinations are as follows, using 1 to represent "pressed" and 0 to represent "unused":

Key	4	5	6
1 key	0	0	1
	0	1	0
	1	0	0
2 keys	0	1	1
	1	0	1
	1	1	0
3 keys	1	1	1

My amazement is that this rather simple and elegant application of binary counting was not obvious to either the programmer or any of the applicants. Does my solution qualify me for the Crude Programmer of the Year Award, or perhaps a free programming course from Michael Smith?

Brian Robinson,
Lancaster.

Road Racing

I AM SURE many readers must have noticed that Road Racing in March's Open File, Tandy Forum, does not work very well if entered as printed. The program is improved by changing the following lines:

```
160 PRINT @19,"SPEED (10-70 etc.
530 IF ZQ=3 THEN X=X-1:Y=Y-1
550 IF ZQ=8 THEN Y=Y+1
555 IF ZQ=9 THEN X=X-1:Y=Y+1
```

N S Grant,
Heald Green,
Cheadle.

Input or Get?

I ENTIRELY AGREE with the April editorial, "Canned thoughts". One of the reasons why the concepts used in computing are all about computers, rather than the uses to which computers are put, is that people who make a living out of programming come to think that programming is a useful activity in itself, rather than a service to other people.

Even though programmers work with new technology they often hold the "We have always done it this way — therefore it cannot be done any other way" attitude to their work. It is reflected in the actual code written and one particularly infuriating custom is the way in which you have to press Return after you have entered data into the computer before it will stir itself into action. This dates back to the days when you had to use a teleprinter to get information in and out of a computer.

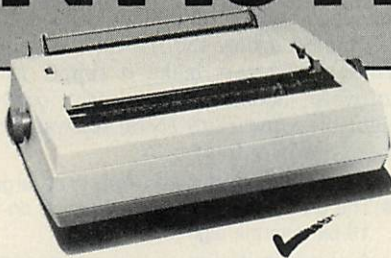
(continued on page 45)

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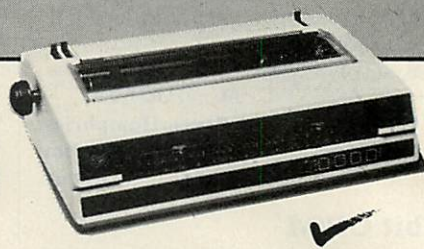
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continued from page 43)

Programmers who write games do not use the Return key in this way. Would Space Invaders have caught on if you had to press Return to make your missiles fire? The standard reply to this is, "We need a non-QWERTY user interface".

Yet there are many Space Invaders games that use the standard computer keyboard. Programs can be written which do not require the user to press Return; the problem is that many programmers do not choose to write them.

It is particularly absurd when menu-driven programs require you to press Return after selecting each option. "Please press 1, 2, 3 or 4", says the computer. The new user cautiously presses 1; a 1 appears on the screen, but nothing else happens. After a long pause the user decides he has done something wrong, and that he is not clever enough to operate a computer. So he goes off to a computer expert, who often deals with this kind of query.

"It's quite simple", he says. "Although you pressed 1, it has not been entered into the computer". The user, who can see that the 1 is in the computer by looking through its glass screen starts to wonder why his common sense has failed.

Who is wrong? Is it the user, or is it the programmer who used Input out of habit, when he could just as easily have used Get and avoided all the confusion?

J Read,
Martock,
Somerset.

● If the program never wanted more than single-digit inputs, then Get or its equivalents would be fine. But what about questions that like, "What is the most you would pay for a car?" which has to be able to accept from one to seven digits. The only way the computer can know that you mean £700 and do not intend to go on to £7,000 is if you press Return when you have finished. So why should menu options take effect immediately while prices, which are numbers just the same, do not? It seems reasonable to train the user to hit Return after every entry, rather than to discriminate in a way that may not be understood.

Disc dialogue

I FOUND THAT QERA, in the January 1982 issue, would only work under special circumstances. The problem was traced to the fact that Num is not cleared at the start, so the program cannot tell reliably when it has reached the end of the list of "candidates for deletion".

The problem is easily corrected by inserting two lines after the first Push HL:

```
LD A,0
LD (NUM), A
```

When it runs correctly, this is a useful facility — many thanks to David Meeks,
David Coates,
Research Machines,
Oxford.

Apple SI card

WE HAVE recently purchased two Paper Tiger 445 printers for use with our Apple II systems. We are using the standard Apple serial interface card and have uncovered what appears to be a serious shortcoming in this card, at least as far as the use of the Paper Tiger is concerned, and possibly for other printers too.

The problem occurs when listing long programs. After a certain point the listings become garbled, with whole portions missing. It was clear that data was still being sent to the printer while its 2K buffer was full, and a temporary solution was to lower the baud rate from 1,200 to 300. On closer examination we discovered that the interface card has no provision for honouring the "buffer full" signal from the printer. The Data Terminal Ready line, pin 20, from the printer is set low when the buffer is full. The corresponding pin on the serial interface card is not connected and there appears to be no way of utilising the "buffer full" signal without making modifications to the card itself and the controlling software.

Have any other readers encountered this problem, and what solutions have they found?

P E Roberts,
Halton College of Further Education,
Widnes,
Cheshire.

Adventure history

HAVING RECENTLY invested my usual 80p in a copy of *Practical Computing*, I was pleasantly surprised to discover an article in the March issue on my favourite type of computer games, Adventures. Although the article by Dennis Ellis was good it appears to be lacking in a few aspects.

That Adventure games are based on Dungeons and Dragons is, of course, beyond doubt, although I would quibble with the general impression the article gives that Adventure is the more popular of the two. I have been playing Dungeons and Dragons for nigh on eight years, and it is played by more people more often. Those in a position to play both invariably prefer the person-moderated to the computer-moderated game.

Although most of the history in the article is correct, I would argue that Zork was a watered-down version of Dungeon. The Zork available on micros is, moreover, a watered-down version of a Zork running at MIT's artificial intelligence labs on a PDP-11. I used to play from time to time over the EPSS/ARPA nets, before British Telecom changed EPSS to PSS and started charging money.

The statement that there are no multi-player, Adventure-like games simply is not true. It may be true for micros, but for nearly four years the Essex University PDP-10 has been blessed with a

program called MUD — Multi-User Dungeon. MUD allows up to 36 players in it simultaneously, and was developed by the Essex University Computer Society.

The setting for MUD is The Land, which consists of about 330 areas called rooms, although many are above ground in a kind of mappable wilderness. Rooms can be chained together so that the environments between the MUDs remains consistent and the passage imperceptible — except that you can not yet take things with you or talk across the programs.

Not only did we frequently go to America via the satellite links for the odd game of Zork, but they came over in droves to play MUD. The vision of playing people in Australia is not all that strange: we regularly killed people from MIT, Stanford and UCLA.

Richard Bartle,
Colchester
Essex.

Grandfather Clock

APPLE PIE in the March issue included R D Walker's Grandfather Clock. I think he must have been so excited with the result that he did not wait for an hour before writing in with his program: the program as published crashes when the clock tries to chime for the second time.

However, all is not lost if you insert the following lines:

```
8 GH = 19
5081 RESTORE
5082 FOR DT = 1 : READ WE : NEXT DT
```

Michael Trinder,
Sunningdale,
Berkshire.

Tangled web

WE WERE PLEASED to be mentioned as suppliers of Apple software in the article on Adventures in the March issue of *Practical Computing*. We would like to remind readers, however, that our telephone number is 01-680 0267, and has been for some six months.

Dick Williams,
Spider Software,
Croydon,
Surrey.

Nascom Adventures

I READ WITH great interest the Adventure article in March 1982 *Practical Computing*. It is gratifying that microcomputer games are moving away from pub games like Space Invaders, towards games with a tendency towards artificial intelligence. However, the article does give the impression that very few Adventure games are available for the Nascom 1 and 2 range of computers. For several months now, we have been selling a very popular compact 16K version of the mainframe Adventure.

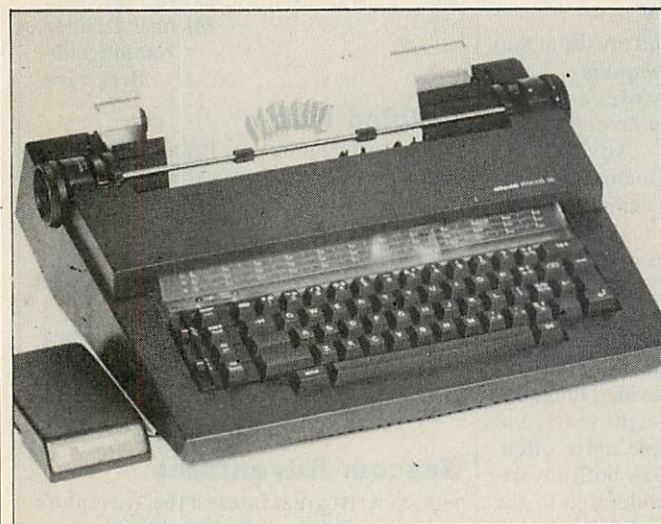
M J Evis,
Syrtis Software,
Bridgwater,
Somerset. □

Triple guide to software products

FOR EVERY PROFESSIONAL involved in computing, the International Directory of Software is a must. The book contains 1,360 pages packed with information about systems available in both Europe and the U.S. A total of 4,026 products are listed, more than half of which are appearing for the first time.

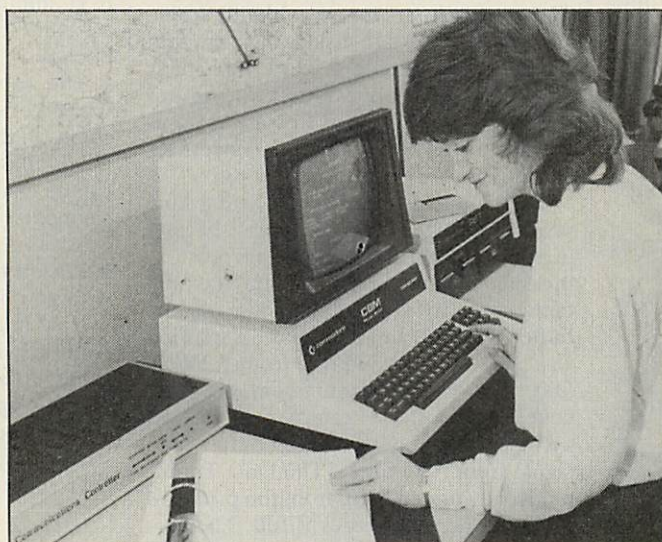
Data is indexed in three different ways. Once the relevant product has been identified, the user may discover such details as its date of origin, terms of purchase and operational mode.

The directory is not cheap — at £48 per copy plus postage it costs almost as much as some items of software contained within it; however, it will be of great use to dealers and computer department managers. For a copy of the directory contact Computing Publications Ltd, 430 Holdenhurst Road, Bournemouth, Dorset BH8 9AA. Telephone (0202) 302464. 



This T/Printer 35 is not only the lowest-priced read-only daisywheel printer on the market, but it is also an electronic typewriter off line. At £475 it is an ideal choice for smaller microcomputer users, who might need letter-quality printout from a word-processing package. The printer is based on the Olivetti Praxis 35 portable electronic typewriter and is comparable in price to many matrix printers. It has a lightweight ABS moulded carrying case, takes paper up to 12in. wide, uses the standard character wheels and can print 120wpm from a microcomputer. Special facilities include variable pitch and numerical fractions. Centronics parallel interface is standard, RS-232 costs extra. For further information contact Datarite Terminals, 144-146 High Road, Chadwell Heath, Essex RM6 6NT. Telephone 01-590 1155. 

Bureau link boosts Pets



T-Pert's way along the critical path

PERT IS a well-known technique used by planners to help arrange work in progress in such a way that wasted time is minimised. Also known as critical path analysis, the methods employed are well-suited to microcomputer

application. In the past there has been a lack of appropriate software, but this has now been changed with the introduction of T-Pert written by the Leatherhead-based software house, Thorncroft Manor Services.

Despite the fact that T-Pert has been written in Fortran it will run on any CP/M system with 64K of memory. Up to 750 activities can be time analysed and monitored simultaneously. The package is available to end-users at a recommended price of £465. The results of time analysis are printed out in bar-chart form and printouts are produced giving the permissible timings of activities.

Activities are defined by start and finish nodes, which are numbered. The duration of the activity is then given, and it is also possible to include a text description.

The most common usage of this type of software is in the construction industry where — to quote an obvious example — the roof cannot be put on a house until the walls are completed.

Because T-Pert is available on a microcomputer, work can be carried out on-site for more effective management.

For further information on T-Pert contact Thorncroft Manor Services. Telephone (0372) 376756. 

THE COMMODORE PET computer can now be used as a terminal on-line to a mainframe computer bureau. The Pet requires the addition of a £900 terminal emulator, but is still cheaper than a dedicated terminal. Savings are particularly attractive to those users who already possess Pet computers, which retain their stand-alone computing power.

The new service has been established by the Midlands-based ACT. Managing director Tony Bryan said, "There are a lot of Pet users in the U.K. who may eventually find that the system is not powerful enough for all their processing needs. Instead of discarding the Pet, and buying a bigger system, they now have the option of linking into a bureau".

The bureau is based on an ICL mainframe, which can be accessed by the micro using either a telephone dial-up line or a leased line. Once on the system, a number of commercial accounting procedures become available on a batch or an interactive basis. The scheme represents a new low-level entry point into the world of commercial computing. For details of the ACT bureau service phone 021-454 8585. 

Ricoh-based daisywheel to mimic Diablo

THE RICOH printer mechanism reviewed in the March issue of *Practical Computing* appears on the market in several guises. One widely advertised incarnation, the Ricoh RP-1600S, seems from the specifications to merit separate coverage.

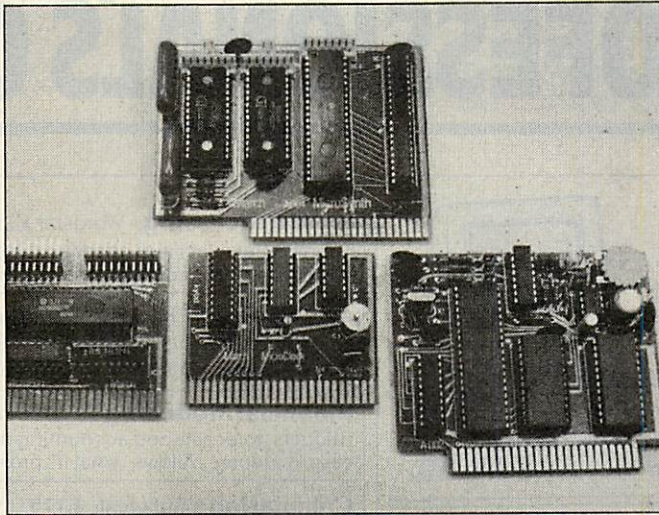
The Cheshire firm of Micropete has beefed up the basic Ricoh carcass with a Z-80 processor board, incorporating a buffer that offers bi-directional printing facilities similar to the Flowriter. Unlike the Flowriter, which has chosen to be a Diablo look-alike, the Micropete "S" emulates the Spinwriter, thereby standardising its method of accessing the additional characters on the Ricoh wheel. 

Matsushita's hot graphics

A VERSATILE 40-column bi-directional thermal printer, the Matsushita EUY-3T, is now available in the U.K.

Its graphics facility, which uses a nine-by-280 dot matrix, can be put to a wide range of uses, including microcomputer terminals, personal computers, instruments and point-of-sale terminals.

Contact GMT Products, Newport House, 22 Hartfield Road, London SW19 3TD. Telephone 01-947 7234. 



Marchcards are plug-in PCBs for the Apple II and Apple III micro-computers. Top of the line is Microsynth, a sound and music synthesiser card which uses the popular AY-3-8912 chip. Also included are Microtalker based on National Semiconductor's Digitalker, an eight-bit parallel input/output card called Microport, and the real-time Microclock. All come from March Communications, 14/16 Manchester Street, Liverpool L1 6ER. Telephone 051-236 2000. 

Spectrum will carry the Sinclair colours

AMID A CRUSH of photographers to rival a Hollywood première the Sinclair ZX Spectrum was launched at the *Practical Computing/Your Computer Fair*. Nobody was quite clear whether the star was Clive Sinclair, or his new microcomputer — though the machine itself deserves to be a winner. A number of people in the microcomputer business are likely to be losing some sleep over their powerful new competitor.

As expected, the Spectrum is a colour machine, with eight available colours all of which may appear on the screen at the same time. It also includes a sound generator.

Attractive as these features are, the main selling point of the Spectrum will be that it is possible to buy a 16K micro-

computer for only £125. For those with a little more ready cash, a 48K version is available for £175. Memory expansion from the basic 16K machine to 48K will be available for around £60.

Like its precursor the ZX-81, the Spectrum comes in a smart little black box, measuring just 8.5in. by 5in. by 1in. There is a new 40-key ASCII keyboard, and the Sinclair Basic has been beefed up. The extra commands take control of the micro's colour facilities and operate Sinclair's new ZX Microdrives

ZX Microdrives are tiny tape-loop units that can hold up to 100K of program or data. Information is transferred from them at a rate of around 16K per second, filling the 48K Spectrum in three seconds. As yet, only the pro-

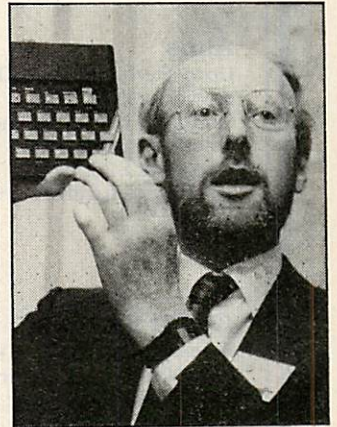
totypes have been built but full production is promised soon.

Up to eight Microdrives can be connected simultaneously to a ZX Spectrum. The quantity of on-line data which may be stored can be increased still further by using the Spectrum's networking capability.

Microcomputer networking is all the rage these days and Sinclair is no slouch when it comes to keeping up with current trends. The networking and RS-232 board is an optional extra, soon to be available at about £20.

The Spectrum contains a 16K implementation of the Sinclair dialect and program conversion to and from the older ZX Basic should be fairly easy. There are 13 new commands and the language can now accommodate multi-statement lines.

The new commands will be bound to delight Sinclair users. Beep will enable the Spectrum owner to enter the fertile pastures of computer music, with over 10 octaves of sound available through an internal speaker or via a jack socket. Ink, Paper, Bright, Flash, Over, and Inverse control the colours and brightness of the screen plotting. The Verify command enables the user to check stored data. The Border command controls the border colour, and Data is a long-awaited addition, providing the standard Basic Data control command together with



Read and Restore facilities.

The new machine comes with two manuals, one being an introduction for the newcomer to computing, the other a Basic manual. The ZX Spectrum will be available by mail order only from Sinclair Research, Freepost, Camberley, Surrey GU15 3BR. 

Self-contained stock system

A COMPREHENSIVE stock-management system incorporating sales and order processing has been designed for the first-time computer user by Winchester-based Inchico Business Systems. The system can tackle stock recording, order entry, invoicing, purchasing and stocktake. It will build up a 12-month usage history and allows the user to view, amend or update purchase orders at any time.

Prices start from under £4,000. Contact Inchico Business Systems, Microcomputer Business Systems, 13 City Road, Winchester, Hampshire. Telephone (0962) 51930. 

Moving keys, not touch-sensitive pads, are used by the Spectrum.



THE PROFESSIONAL'S CHOICE

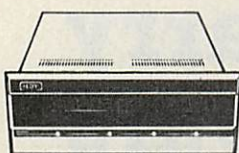
Act Sirius 1

16 Bit Stand Alone micro with superb features. 128K, 1.2MB Floppies. CPM86 as standard - £2395.



Altos

Up to 4 terminals and 40MB of Winchester Disc. One of the biggest selling small business systems starting at £2350. 16 Bit system with 8 terminals available soon.



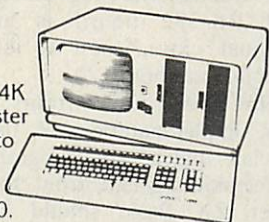
OKI 1F800

Quality graphics micro with full colour screen and integral printer. 64K and Basic are standard - £4750. Wide range of peripherals available.



LSIM3

High specification Stand Alone micro. CPM, 64K and up to 10MB of Winchester in one package. Very easy to use. Detachable keyboard. User programmable function keys. From £2250.



Superbrain

Still a leader in 8 bit price performance. KGB having sold over 400 Superbrains has unbeatable experience on them. From £1875.



Word Processing - Wordstar £250, Mailmerge £75.

Full on-screen facilities enabling the printing of standard letters and preparation of mail shots.



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Sales Office Management - Sales Desk £300.

For the busy sales office to manage sales leads and marketing lists.



Accounts - IRIS £750.

Incomplete records and time recording systems.



Payroll - Graffcom £500.

Up to 500 employees both weekly and monthly paid. Automatic deduction for items like company pensions.



Graphics - Price depends on application.

Full on-screen graphics both colour and black and white.



Engineering - SPERT £450.

Suite of programmes for PERT analysis and civil engineering applications.



Communications - Liberator £250.

Enables a micro-computer to act like a mainframe terminal and transfer data from Floppy disc to another computer.



Languages - From £175.

Most major computer languages are available: Basic, Cobol, Fortran, Pascal and Assembler.



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ICL advances into the microcomputer market

FOR SEVERAL MONTHS now there have been rumours that ICL is going into the microcomputer business in a big way. First came the news that the British computer giant was going to market the Rair Black Box range of microcomputers under an ICL label. Now the company's plans are brought into perspective its Trader Point scheme.

Trader Point is, as its name suggests, a marketing strategy. It is a bold venture, both from the point of view of ICL and the dealers who enter into agreements with it. Robb Wilmot, managing director of ICL, admits that the company did not know much about the microcomputer market, but is willing to learn.

It is this frank confession by Wilmot that points to the future of ICL — one that certainly looks much rosier than it did a year ago. Because ICL knows little about the micro market, it is prepared to lend its name and expertise to the

dealers who, in return, will sell the machines for ICL. Some dealers are expressing concern that they will be competing for sales against ICL salesmen. Others are worried that the lack of local licence agreements will usher in cut-throat selling, signifying the destruction of their businesses.

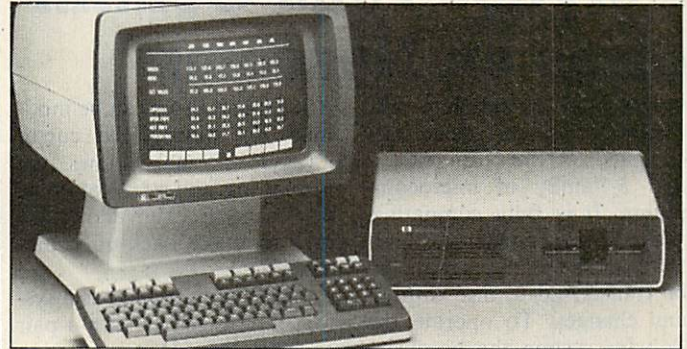
Despite these fears, the microcomputing industry should benefit by this new development — not least from the prestige bestowed by the famous ICL. Trader Point is not just concerned with selling the new ICL microcomputer, though the machine should make up the bulk of these sales. Other machines covered by the deal are the Wordskil 8800 range, which is a highly sophisticated word-processor based networking system, the system 25, and a very up-market graphics computer; known as Perq.

The ICL personal computer is expected to sell in very large quantities. According to the

sales team at ICL, the biggest buyers will be large international and national companies. The main competition is expected to be the IBM personal, which is not yet officially on sale in Europe.

For details about Trader Point or the ICL micro contact ICL at its World Headquarters, ICL House, London SW15 1SW. Telephone 01-788 7272.

HP-125 prices falling as hard disc arrives



THE NEW HP-125 Model 30 is based on a 5.25in. Winchester hard-disc drive, coupled with a 5.25in. floppy in a dual-drive enclosure. Also included in the basic machine are two Z-80 microprocessors, 64K of RAM, 16K display memory, keyboard, and the display unit. The system is the third in the HP-125 range and costs £5,473.60.

Hewlett-Packard claims the new machine offers increased data reliability thanks to the Winchester discs which are sealed against attack from external agencies. A further advantage is the increased speed, and the final benefit is the massive increase in on-line storage.

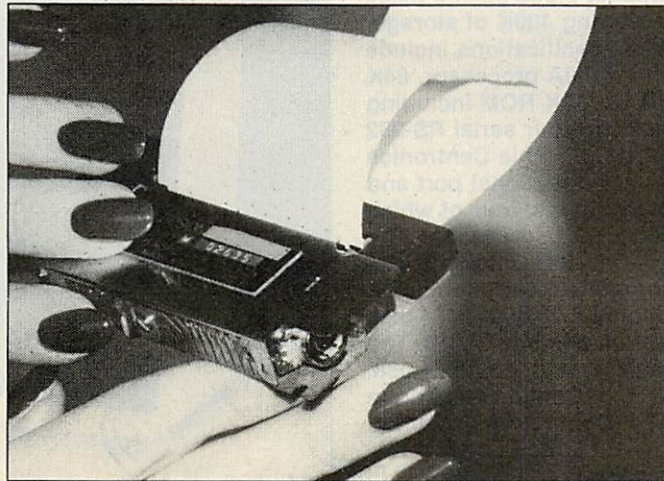
To coincide with the introduction of the new HP-125 Model 30, Hewlett-Packard has reduced prices on the other models in the HP-125 range, which now starts at £3,238.84. Contact Literature Enquiry Section, Hewlett-Packard Limited, King Street Lane, Winnersh, Wokingham, Berkshire. Telephone (0734) 784774.

Magic spells with CP/M

BRITISH SPELLGUARD is the first truly Anglicised spelling checker for CP/M machines. It will run alongside all the popular CP/M word-processing packages such as Wordstar, Magic Wand and Electric Pencil. The program is based on an American version which has sold over 3,000 copies in the U.S.

The program is available on either 8in. or 5.25in. floppy discs formatted for most popular microcomputers, and comes together with a 116-page instruction book. At a cost of £179 the program comes with a money-back guarantee. Spellguard is fast, being able to read 20 pages in under one minute, and has a dictionary of 20,000 words which may be expanded by the user. For details contact Vision Associates, 57 Woodham Lane, New Haw, Weybridge, Surrey. Telephone (0932) 55932.

This is the world's smallest dot-matrix printer, the ultra-miniature model 150 from Epson (U.K.). The micro-dot printer has been designed to be used in pocket calculators, smaller computers and various other devices. The print head is of the impact dot-matrix type and can print a maximum of 96 dots per line or 16 columns of five-by-seven matrix characters, on 45mm. width paper. The speed of printing is approximately 1 line per second. Ribbons are provided in single-colour cassettes, either in purple or black. The printer uses a 4.5V power supply and the motor draws a current of 0.17A. The overall dimensions of the printer are: width 73.4 mm., depth 42.6mm., height 12.8mm., weight 60g. Further information is available from Epson (U.K.), Dorland House, 388 High Road, Wembley, Middlesex. Telephone 01-900 0466.



Daisywheel typewriter is Canon's new venture



Polydos runs Gemini discs on Nascoms

POLYDOS is a complete disc operating system specifically designed for the Nascom 1, 2 and 3 family of microcomputers. It is fully compatible with software written for Nas-Sys 1 or 3 so that programs can be transferred to disc without any changes. To operate the Polydos system the hardware must have a minimum of 48K RAM and either a Gemini GM-815 floppy-disc system with the GM-809 controller card or the GM-805 floppy-disc system.

Operating under Polydos the GM-815 disc system supports both double-sided, single-density and double-sided, double-density discs which yield 175K and 315K of storage per drive respectively. The GM-805 system supports the single-density format only. Discs in the single-density mode may be interchanged between the two drives.

Polydos includes a 4K extension to Basic, a disc-based editor and an assembler. All existing Basic programs will run without any modification. The disc assembler, called Polyzap, is claimed to be the most advanced assembler ever written for the Nascom microcomputers.

Three utility programs are supplied with Polydos; they are Superzap, Format and Backup. Superzap allows the editing of disc sectors; sectors are displayed in hex and

ASCII, and bytes can be modified by moving the cursor around. Format allows the formatting and verification of discs, and Backup allows the user to make back-up copies of discs.

Polydos is supplied as a system disc, together with a pair of EPROMs. Documentation is divided into five manuals, and the whole package costs £90 plus VAT. Polydos is available from Microvalue dealers.

This is a new all-British microcomputer, the MC Combo. Designed and built in the U.K. this CP/M-based business system is capable of conversing with mainframes. The basic machine comes with twin double-density, double-sided 5.25in. discs offering 400K of storage. The specifications include Z-80A processor, 64K RAM, 12K ROM including monitor, four serial RS-232 ports, a single Centronics bi-directional port and eight timers, four of which are user addressable. The

MC Combo is IBM compatible and there is an optional 6.9Mbyte hard-disc system costing £2,950. The basic system costs £1,088.

Contact Megabrain Computers, 2 Ganton Street, London W1. Telephone 01-734 9462.

ALREADY RANKING among the world leaders in plain-paper copiers, Canon is preparing to tackle the market for electronic typewriters with its AP-500 and AP-400 machines, which are now available in the U.K. Each machine is controlled by a microprocessor which will help to eliminate chores like centring, column layout, and margin and tab setting.

The top of the range, the AP-500 retails for £1,425. Its special features include a 2K memory which can be expanded to a maximum of 32,000 characters in 10K steps.

The AP-400 costs around £840 and has a 500-character memory, and automatic selectors for pitch, line-space, punctuation, keyboard, impression control, carrier return and underlining. Both machines have a line-frame function for graph and chart construction, a daisywheel print mechanism and an output speed of 20 characters per second. For more information, contact Canon (U.K.), Waddon House, Stafford Road, Croydon, Surrey CR9 4DD. Telephone 01-680 7700.

Twin Z-80s and 64k RAM stars of Galaxy I

GEMINI MICROCOMPUTERS has introduced the Galaxy 1, a microcomputer built around Gemini's Multiboard system. The Galaxy 1 includes twin Z-80 microprocessors, 64K dynamic RAM, a detachable 59-key keyboard and two



double-density 5.25in. floppy-disc drives.

The Galaxy 1 provides a number of sophisticated video facilities. Full cursor-control functions give the user comprehensive on-screen editing capabilities.

Centronics and RS-232 interfaces permit the use of parallel and serial printers. A 1,200 baud Cuts cassette interface and a light-pen input are also included. The Galaxy 1 costs £1,450 plus VAT from Gemini Microcomputers, Oakfield Corner, Sycamore Road, Amersham, Buckinghamshire. Telephone (02403) 28321.





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22. Full support for VIC owners – their own magazine 'VIC Computing' as well as a national network of VIC user groups.

23. National dealer network providing full service and support to VIC owners.

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Prestel all at sea



Bill Bennet investigates a tele-computing experiment on board a North Sea ferry.

SEAVIEW 82 is one of the simplest, yet also among the most imaginative applications of the British Telecom Prestel system. Essentially it is a way in which shipboard Prestel sets can patch into the network. None of the technology involved is particularly novel, but as with all worthwhile feats of engineering it is the way that existing technologies are combined and applied that is important.

The prototype system is on board the Townsend Thoresen car ferry *Viking Voyager* which treks back and forth across the North Sea between Felixstowe and Zeebrugge. The link into shore-based Prestel is achieved by radio, as with normal ship-to-shore telephone network links, and the base-station radio receiver links into the telephone network.

The funding of the trial — which will cost in total £325,000 — is being met by a number of sources, with the lion's share of 70 percent coming from the Department of Industry. These funds are in addition to the costs met by CAP and Siemens who conducted all the earlier research and development. The money from the Department of Industry comes under the Information Technology Year budget.

Ministerial optimism

The system was recently demonstrated by Under Secretary of State for Industry, John Wakeham, who commented that the project was very much in keeping with the spirit of IT Year. He also envisaged a future system where ships all over the world would be able to contact the Prestel network via communications satellites.

To send the digital signals associated

with Prestel, a special type of hardware is required which combines elements of digital and radio techniques. The nominal range of the ship-to-shore VHF radio is about 20 miles, though useful communication can still be achieved 24 miles out. Thanks to the international Gateways in Prestel it is possible to contact other countries' viewdata networks. Especially relevant in the North Sea and English Channel areas are the German and Finnish networks.

Coastal relays

The Seaview system itself was invented by a team from the systems house CAP, which specialises in providing purpose-designed systems to clients' specifications, working in conjunction with a team from Liverpool Polytechnic and Siemens. The communications links for the Seaview system are provided by British Telecom. In all there are 11 manned and 19 unmanned VHF radiotelephone stations dotted around the coast of Britain, and more are on the way.

Ships normally operate a telephone service both for the benefit of the passengers and for the day-to-day business of running the vessel. For the purposes of the Seaview demonstration, at least one of the radio-telephone channels is occupied by the Prestel link.

One of the major partners in the Seaview venture is Townsend Thoresen, the ferry company that is actually using all the high-powered technology. Townsend Thoresen's Felixstowe operation thinks of itself as the technological vanguard of the fleet, and in Seaview it sees an opportunity to keep itself well at the fore of sea-borne information technology.

Why should a ship need Prestel? Of course it is a convenience to have a link to the Prestel service that can be used from a ship, but more to the point it establishes a communications link that will support digital computer signals.

Connecting the ship up to the Prestel system provides the sea-borne user with an interesting set of possibilities including access to distant databases through the Prestel Gateways. In this way for example, an on-board computer is able to patch in to the fleet's main base computer.

Duty-frees

Cross-channel ferries make most of their profit from the duty-free shops and the on-board bars and catering, and it is replenishing these lucrative stocks that takes most of the time when the ferry is in port — clearly an unsatisfactory state of affairs for the ferry operators and the port authorities. Turn-round time can be reduced by the ship's computer contacting the stores computer in advance to ensure that the required supplies are waiting on the quayside.

A service which could make Seaview very popular with the ferry-using public is the facility to book hotel rooms at their destination while still on the boat. Motorists could be informed of traffic hold-ups well in advance of reaching them, and the general news and information services should prove useful to passengers on longer journeys. The expense of remaining on-line to the Prestel network can be cut considerably by saving the pages to tape or disc, and reviewing them later. This would be normal practice prior to leaving the limit of VHF transmissions. □

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Advantage of graphics



With the Advantage, North Star has produced yet another desk-top micro with built-in discs: Mike Hughes found that it has something special to offer.

THE NORTH STAR Advantage is a Z-80-driven integrated desk-top system comprising 64K of main memory, a 20K high-resolution monochrome display, a 2K bootstrap PROM, 87-position keyboard and twin double-sided 5.25in. hard-sectored disc drives. A second microprocessor, an 8035, is used within the system to provide keyboard and disc-drive control. It will support serial or parallel external printers via plug-in I/O boards, for which there are six slots inside the cabinet. There are currently two I/O-board options — one serial and one parallel.

Keyboard

The keyboard contains three shift keys, designated Shift, Control and Command. Used in conjunction with the other keys, they generate up to 235 different codes. Through software, a "feedback" click can be made to sound whenever a key is depressed. The main keyboard contains an Alpha-lock key which, when active, is illuminated by an LED. Alpha-lock can be switched in and out either manually or through software. The numeric pad carries a similar Cursor-lock key which allows eight of the numeric keys to double as cursor-movement controls. Cursor-lock can be introduced either manually or via software. A further 15 keys, labelled F1 to F15, can be used for special user functions.

The display, when used in conventional character mode, displays 24 lines of 80 characters per line, with each character contained within an eight-by-10 matrix. The matrices for standard characters are contained within the 2K Boot PROM, and provide for proper descenders on lower-case letters. The PROM contains the character-driver routines which are accessible to the user, and allows matrices for special characters to be set up and addressed in RAM. Because of the high-resolution characteristics of the screen, characters do not have to be separated by fixed line intervals. It is possible, with custom-designed software and character pixel data, to display superscripts and subscripts, and even display sloping lines of characters. All this can be done by transporting data to the driver routine via the Z-80's registers. In graphics mode the 20K of display RAM allows every bit to be displayed giving a truly high-resolution display of 240 by 640 pixels.

The versatile video driver allows for reverse-field characters and stepwise or smooth scrolling. Other software permits the cursor to be extinguished, and there are routines which allow the screen to be blanked through software without affecting any writing in progress. A complex drawing can thus be entered with the screen blank, to be switched on subsequently to show the completed drawing.

The Boot PROM allows the system to be loaded from either of the two disc drives, which proved useful on the review system as it slowly developed an unwillingness to read through drive 1. This was probably a simple mechanical problem on an "as delivered" machine and would have been cleared up by an engineer's visit. This brought drive 2 into the limelight which, although a little inconvenient at times, allowed the system to operate satisfactorily. The transfer rate when taking back-up copies of discs appears to be rather slow. Comart confirms that this is so and puts it down to the disc drives being controlled via the firmware of the 8035, as opposed to a hardware control chip.

Memory addressing

The internal "bleep" loudspeaker is driven either from a standard 500ms. bleep, generated by hardware and controlled by a monostable, or from a programmable frequency tone generated by switching a bit in an output register.

Extended memory addressing is used to keep control of up to 256K which is organised as 16 16K pages. The address bus is increased to 18 bits by using bits 14 and 15 to address four registers into which four data bits are loaded to define the pages that are currently required. The normal bits 0 to 13 then address the 16K within each of the selected pages. At any moment only four 16K pages can be current — for obvious reasons. Though this program is very powerful, it could cause a few programming headaches if put to a great deal of use, especially if maskable interrupts are used when the page they are on is mapped out of the system.

Parity checks

The internal 64K of dynamic RAM occupies four of the 16 pages and is unusual in being nine bits wide. The extra bit is used as a parity bit for every memory location and is automatically checked by hardware. In the event of parity failure the hardware can flag it by issuing an interrupt which can be masked out, if desired, by a control register. The parity bit is always set during a write cycle; parity bits could be left in a random state after switching on, so it is essential that all memory locations are written to during initialisation.

The Advantage is well endowed with software control, making it an extremely versatile system. It means, however, that there is plenty to go wrong if the inexperienced start playing around with system software. Fortunately the average end-user need have no fear as the Advan-

(continued on next page)

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tage is supplied equipped with a choice of operating systems, neither of which requires intervention for most purposes. The CP/M supplied is up-graded to handle graphics and North Star's graphics operating system, GDOS; the review model was supplied with CP/M 2.2, a full complement of utilities and a handful of command programs introduced by North Star. The most significant of these are a Graphics Dynamic Debugging Tool, which is an upgraded form of DDT; a program for dumping the CP/M directory called DIRDUMP; and GMGRADD.COM which is a graphics subsystem extension to CP/M which is not normally resident in RAM but which can be linked to users' Com files.

Data passed to the graphics subsystem through the Z-80's registers allows four geometric routines to be invoked which respectively draw lines, ellipses, rectangles or polygons. Bounded areas can

optionally be filled in with 15 different types of shading, and the bounding perimeter can be deleted if required. Like the standard CP/M I/O call at 0005H, the graphics subsystem is accessed through a call to 000CH once the registers have been set up.

Speedy Graphics

CP/M was used to run WordStar with Mailmerge and Spellstar which did all that could be expected of them. Great fun was had writing a few patched-up graphics routines in assembler, and linking them through the graphics subsystem. As long as the required tables of co-ordinates were properly set up, the graphics system made the rest of it very easy. The speed with which the most complex drawings are displayed is a sight to behold — it is not often you get the chance to play around so easily with complex high-resolution graphics in assembler.

MBasic was used to carry out a few groundwork checks on the Advantage and, in particular, some of the numerous software-controlled options. Many pages are taken up in the respective manuals describing the bit patterns of control and status registers. The system is organised in such a way that many of the options can be set up through the display output.

By expedient use of the Print CHR\$ statement, you are able to switch to reverse video, switch the keyboard "click" on and off, sound the "bleep", clear a line, clear the screen or clear to end of screen, turn on smooth scrolling at high or low speeds, switch the cursor on or off, or switch the display on or off. It is very disconcerting to switch off the screen by using the Print CHR\$(29) statement as the last in the program — you tend to draw a blank if you then try to find out what has gone wrong.

It is also possible to switch the display into Hybrid mode. It clears the top 20 character lines of the display and reserves this space for graphics, while the bottom four lines continue to be used as a scrolling text area for normal alphanumerics.

Penalties exacted

Impressive as this wealth of options may be, there is a drawback in having so many control options accessed through the Character Out channel. This shows itself when you try to Type a non-printing file when in CP/M's command mode. Strange things may happen when a non-printing code is output: the screen can blank out, the video can reverse, bleeps sound, the keys start to click and, sometimes, you can find yourself "hybridised". Worse still, in a few cases the screen fills up with a pretty pattern and the system crashes. Perhaps it is a just punishment for being naughty, but North Star, through Comart, ought to sort out this problem.

Though the performance of the Advantage under Graphics CP/M is impressive, it is overshadowed by the spectacular things that can be done using North Star's own Graphics Basic which runs under Graphics DOS. It is a full-blown Basic interpreter with a host of special graphics-handling statements. An imaginary cursor can be positioned anywhere within the screen's area by means of the Move statement and, relative to that position, lines, circles, ellipses, rectangles, arcs of circles, "pie-slices" and chorded arcs of circles can be drawn with or without shading.

A sad day

Its simplicity is demonstrated by this two-line program, which draws a near-perfect high-resolution circle of 50 pixels radius centred 100 pixels from the left of the screen and 80 pixels up from the bottom:

```
10 MOVE 100, 80
20 CIRCLE 50
```

Substituting

```
CIRCLE 50,29
```

in line 20 produces a solid circle, and

```
CIRCLE 50,32
```

produces a circular area of diagonal slash lines without an external perimeter line.

The Graphics Basic may not be as fast as doing the same thing in assembler, but it does make complex graphics programs possible even for the most mediocre of programmers. It was, indeed, a sad day when Comart asked for the machine to be returned.

Conclusions

- The Advantage is a compact, highly-sophisticated piece of hardware with a multitude of versatile, software-controlled options.

- It is well supported with software through CP/M and North Star's Graphics DOS and, in particular, Graphics Basic. If WordStar were patched to make use of the 15 function keys instead of the usual control keys for the more commonly used word-processing operations, the Advantage would act as an easy-to-use office letter writer.

- It is housed in a strong cabinet that will easily stand up to a normal office environment. With 720K of disc storage within, it would form a significant small business system.

- Disc-to-disc transfer rates are slower than in other systems.

- The hardware and software documentation presented for review is weighty, well presented and easy to follow. It contains all the necessary facts, but if you wish to make use of the software-controlled options at a system level you will, nevertheless, need to read it very carefully indeed.

- The graphics-handling ability of the Advantage leaves very little to be desired of such a reasonably priced machine, but much of the credit for this goes to the graphics software.

Specifications

Dimensions: 480mm. deep, 510mm. wide, 315mm. high.

Weight: 19.5kg.

Power requirements: 230V/at 1A.

Ambient operating temperature range: 10°C to 40°C; cooling by integral fan.

Central processor: Z-80 operating at 4MHz plus 8035 microprocessor for keyboard and disc control

Memory

Main RAM: 64K by nine-bit (eight bits plus parity)

PROM: 2K by eight-bit; contains Bootstrap

Display RAM: 20K by eight-bit

Video display: 11in. green phosphor screen

Normal display: 24 lines of 80 characters per line

Character matrix: five-by-seven character in eight-by-ten dot matrix

Graphics display: 240 pixels high by 640 pixels wide

Keyboard: 87 keys: 49 alphanumeric, Qwerty layout; 14-key numeric pad; 15 programmable function keys; nine control keys

Disc drives: twin 5.25in. double-sided hard sector; 720K total capacity; 35 tracks per side; 10 hard sectors per track; 512 bytes per sector; 250 kilobits per second transfer rate; 5ms. access time, track to track

Input/output

Integral: internal loudspeaker for bleep

Extendable: six slots for optional I/O boards within cabinet with provision for sockets to the outside world

I/O boards

Serial I/O: RS-232 serial port; current loop option; 45baud to 19.2Kbaud, asynchronous; 2,400baud to 51Kbaud, synchronous

Parallel I/O: eight-bit data in and out, with three handshake lines

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At first sight this European competitor to the Apple looks like an expensive choice but, as Simon Rushbrook Williams has found, it could be the economical alternative for some purposes.

PEARCOM IS A NEW Dutch-built contender for the Apple sector of the market. Although the hardware is different, from the point of view of software it can be made to look identical to an Apple II.

The machine is supplied as a micro-computer frame with 32K of RAM and no software language at all. There are no PROMs on board, and no operating system or monitor programs. The review machine was already fitted with an Apple Autostart ROM set which is recommended by Pearcom. In this way the copyright of Apple software is not infringed.

Pushing the start button illuminates three coloured LEDs. A green glow confirms that power is being supplied, red that the main board has a clock running, and yellow that the keyboard is running, or at least has a pulse train on it. These seem an unnecessary gimmick. If there is a need for indicators of properly functioning boards, then they should be on the boards so they will be seen by a service engineer.

Keyboard quirks

The manual praises the high quality of the reed-switch keyboard but the key-stroke is long, the keyboard is uneven and it feels cheap. Keyboards are personal things and I did not like this one. In addition to the normal keys there is a numeric keypad and seven function keys. Three are used for a special shift function and allow access to the ASCII characters normally forbidden on an Apple. The others are available as user keys.

To the right of the keyboard is a cover held by a screw. On the pictures in the manual and in the advertisements this holds a zero-insertion-force socket, presumably for a PROM programmer, but on my sample there was just a blank panel with ideas in the manual on what to do with it. It can be useful to have a customising area and this should tidy up some applications. It was unfortunate

that the blank panel was on the right of the machine as the main board was below it. If it had been on the left of the machine then the full depth of the case would have been available for circuits without danger of shorting out the board below.

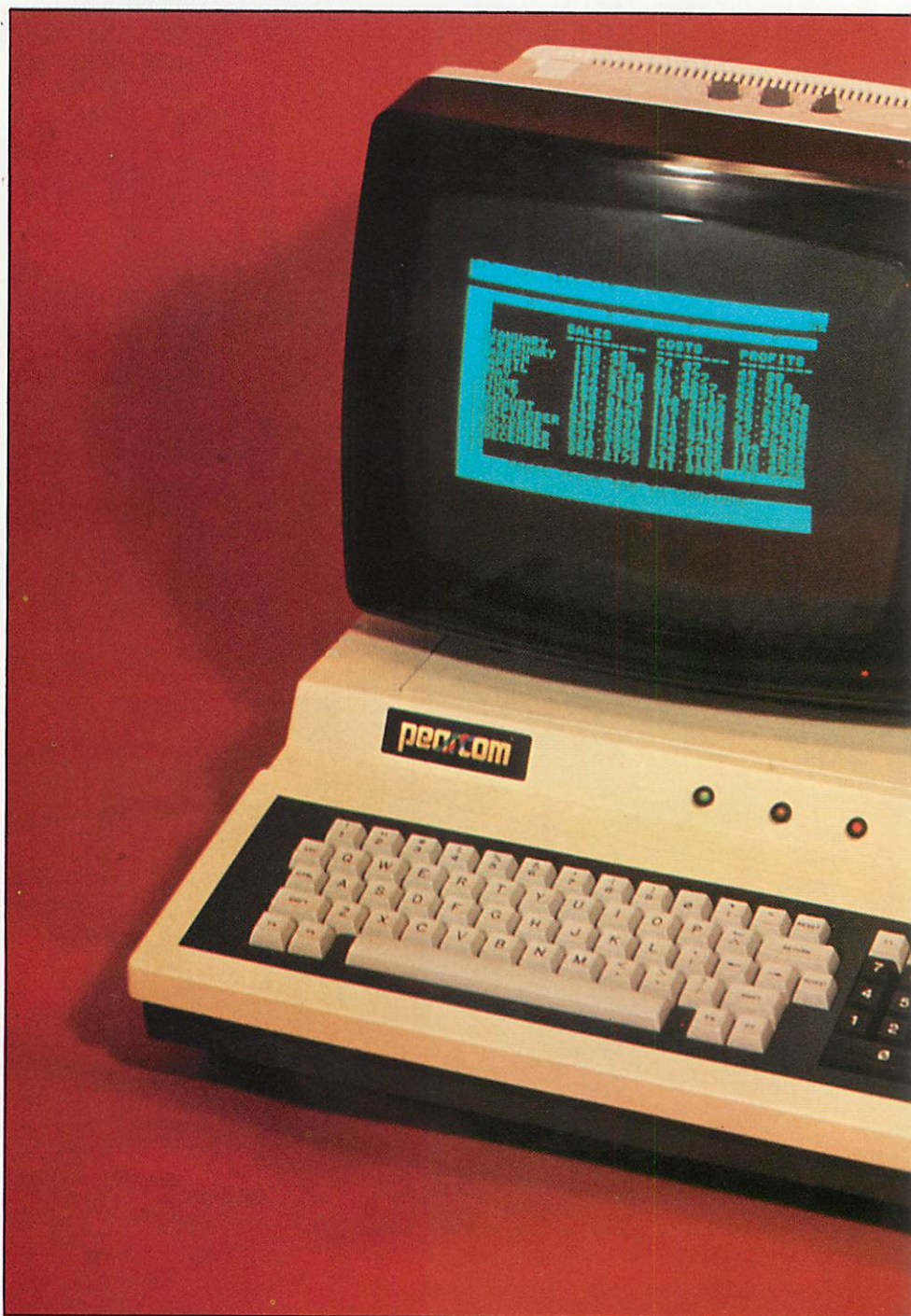
There are four sockets on the side of the case. Two DIN plugs allow connec-

tion to cassette and one of them carries the sound output of the internal speaker so that you can record program output.

One video output is a modulated colour output to a PAL standard, together with a sound carrier, so a TV can give both colour and the output of internal speaker if required. The second output is for a black-and-white monitor.

To compensate for the lack of colour here, a true 16-level grey scale is supplied. This is a very fine feature compared to Apple outputs on a normal black-and-white which are often confusing if colours are used. If you wish to play sound from the TV only, then a volume control for the internal speaker is supplied on the board.

Inside the case there is plenty of space.



Specifications

Processor: 6502, compatible with all Apple hardware and software

Languages: None supplied

Monitor: None supplied; UHF/PAL colour output

Keyboard: QWERTY, numeric keypad and seven function keys

Memory: 32K RAM, expandable to six 96K

Expansion: 14 I/O expansion slots; six ROM or EPROM sockets; bus compatible with Applesoft card

Dimensions: width 520mm., depth 490mm., height 130mm. (all approximate)

Price: £975

PEARCOM



At the bottom is a large circuit board, with 14 I/O slots along the back which are identical to the seven slots to be found on the Apple. The usual games I/O socket is found near the centre right of the board.

The ROM sockets are selectable to be 2716 EPROM compatible or Applesoft ROM compatible by soldering a jumper pair together, so you could make your own system software.

There are plenty of sockets for 4116-type RAM. The basic Apple 48K of RAM is there, although to keep the price below the magic £1,000 figure only 32K is provided. The rest of the RAM sockets are for four extra pages of the top 16K of memory. Any page can be selected but only one can be active at any time.

The output on a black-and-white monitor was excellent and the grey scale improved many of the low-resolution graphics pictures with no harmful effects on the high-resolution output. The colour output to a TV was sharp and good. Pearcom has given four extra colours with the effect that Apple black 2 is now green, so some of my programs produced unexpected colours on a green background. Versawriter confused many colours; however, a few software patches should cure all, and new colours are always welcome.

All of the expansion cards worked without flaw. The Pearcom can work just like an Apple, but if that is all you want then the Pearcom is an expensive way to get it.

Pearcom's control comes from address -16288 or C060 hex, the cassette input port with bit 7 connected to the tape. However, Pearcom has made this a read-write port with bit 7 still as was, bit 6 not used and the lower six bits used to control all the Pearcom goodies.

Bits 5 and 4 control the character set displayed. Both upper and lower case, together with Greek and special symbols reside in the EPROM on the keyboard. What appears on the screen when a key is pressed depends on the value in these bits. If both bits are zero then the system looks Apple-like. If bit 4 is set, lower case is sent to the screen.

With the addition of a little software the keyboard allows proper shift operation. Bits 0, 1 and 3 control the extra RAM, which is configured usefully. If all three bits are zero then the system is Apple-like. However, the top 16K of RAM can be addressed using bits 0 and 1 to give one of four possible pages. So, for example, on a disc boot Dos will reside in the default page. If you now change bits 0 and 1, then Dos no longer occupies the top 10K and you have blank RAM. Obviously your software must handle these bits so that then the 0 page is selected when you want to use disc.

Extra graphics pages

If bit 3 is set to logic 1, then the memory is changed to be page mapped in text, low-resolution graphics or high-resolution graphics, whichever is active. In other words, you now have page maps of your screen. As each screen already has two areas in Apple RAM, pages 1 and 2, you end up with 10 possible text or graphics pages available by changing a single address. Those programmers who already use HGR1 and HGR2 commands will see immediately the use of the extra eight pages. You can have 10 pictures all set up and switch between them in a few microseconds.

The last bit, bit 2, selects which seven of the 14 slots are active. All the DMA and interrupts are active all the time, and while I cannot see how to poll which slot is interrupted, I managed to get a clock running in an extension slot while the normal slots were active and still update software on an interrupt from the clock.

A nice feature of location C060 is that when read, it not only displays the cassette data, but also the current state of your control latches. This makes programs a little easier.

Trial and error

The Pearcom comes with a file-like manual and an address to write to for a year's free update. The translation into English leaves much to be desired, and though a considerable amount of information is included it took a long time to find it. There are technical errors where 8 is printed as 3 or B. There are five pages on binary number systems but only one page on the screen mapping of the extra memory. I found the manual very confusing and often resolved what it meant only by trying out ideas on the machine. It is not for the beginner.

Suggestions for changing component values to increase repeat-key rate, and to solder jumpers on the board were dangerous. While it is often possible to improve or fine tune a board, it is not for a beginner, and unclear instructions in a manual could lead to warranty problems.

If you were to buy an Apple and expand the number of I/O slots, buy a colour card, an upper- and lower-case card and some memory expansion, together with a numeric keyboard, then you would have to lay out more than required if you were to buy a Pearcom, an Apple PROM set and some RAM. For those people who would require these systems extensions, or for a dedicated control unit, the Pearcom frame is ideal. For a user who intends to demonstrate Apple cards or for a research group with a number of I/O cards, the Pearcom could be the solution.

Some problems which present difficulties for an Apple can be solved instantly on the Pearcom. There is a place for the Pearcom in the market, but costing needs to be done carefully.

Conclusions

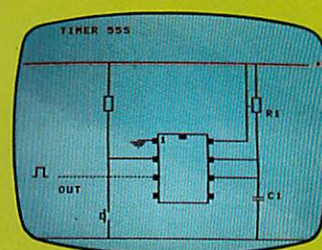
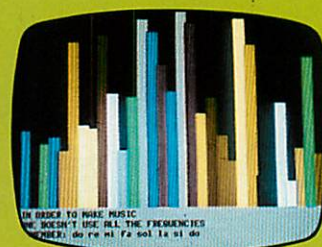
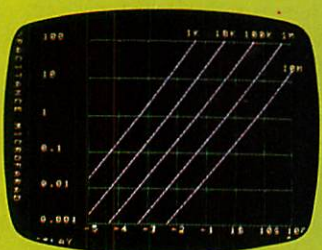
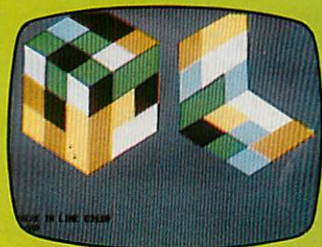
- The system works just like an Apple and all software and peripherals should work.
- The documentation is poor but contains all necessary information if you are prepared to look for it.
- If you do not intend to use the extras, then the Pearcom is a more costly option than an Apple.

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Superbrain prepared for hard times ahead



With a 6Mbyte hard disc in place of one of the mini-floppies, Encotel's modified Superbrain should give you memory to spare. Peter Laurie has been finding out more.

THE ARRIVAL of hard discs in the same size boxes as 5.25in. floppy drives has produced a new kind of machine: the true desk-top information box. The first we have tried is a Superbrain conversion from Encotel of Croydon, using the Rodime system described in December's *Practical Computing*.

The 6Mbyte drive which replaces the second mini-floppy runs under CP/M 2.2. Although the outward manifestations of this change are slight — all you can see is a flat black surface in place of the disc door — the effect on performance is startling. Even more amazing, the thing worked as soon as we turned it on. This is by no means universally true with equipment we get for review.

When the machine is switched on, the helpful prompt appears:

Hit any key to boot off hard disc
F to boot off floppy

On booting, a directory appears of the logged-in drive.

Although CP/M 2.2 will control up to 8Mbyte of disc, Encotel has chosen to split the 6Mbyte available into two 3Mbyte drives, A and B. If you boot off the floppy, they become E and F, while B, C and D are transferable drive names that make it easy to copy from one floppy to another in the single drive.

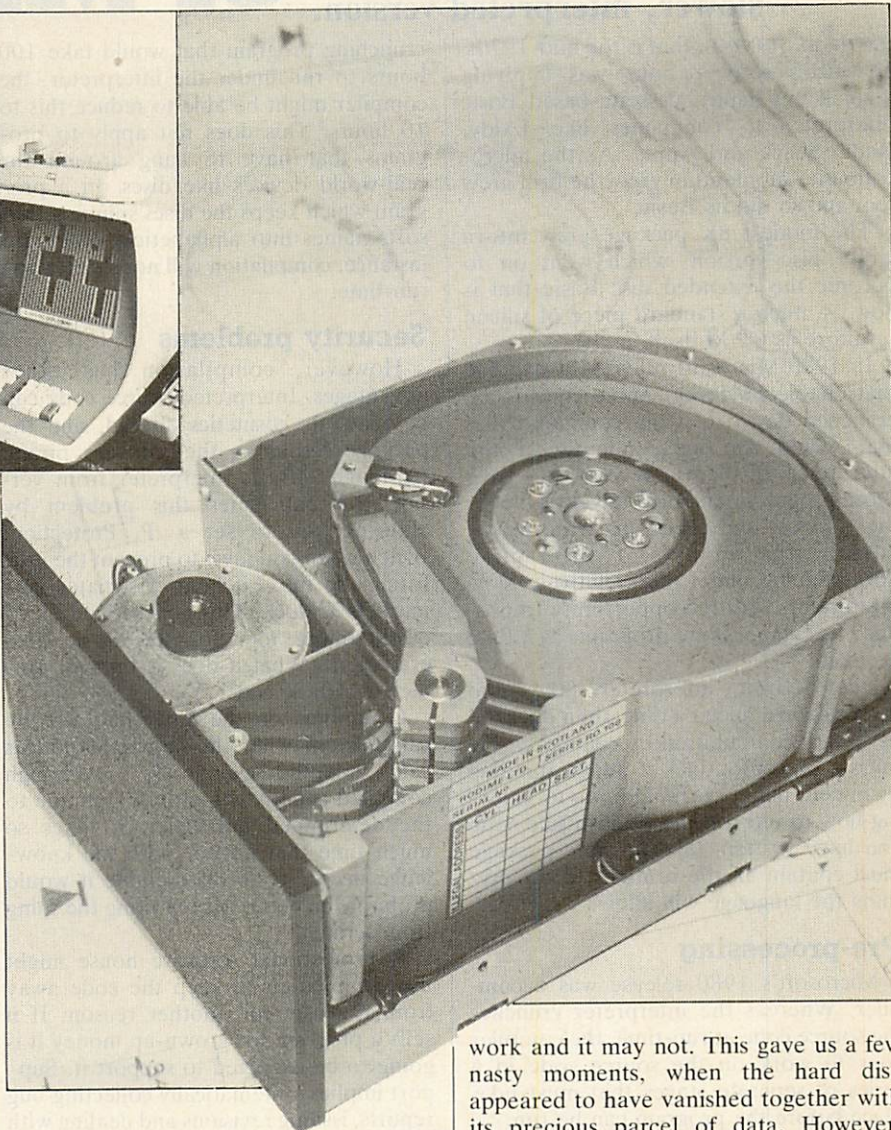
Size is the great asset of a hard disc, though even 6Mbyte — which needs six months' non-stop typing to fill up — disappears surprisingly fast. Speed is also impressive: accesses off the hard disc seemed to be about six times as fast as

those off the floppy. You can take standard CP/M software, transfer it to the hard disc and relax.

Unlike earlier hard-disc drives the Rodime is tough and quiet. You do not need to lock it before you move it and unlock it before you use it. The machine will stand being bumped about from car to desk. In use it is so quiet that you have to press your ear to the casing to detect head movement.

The only defect we found in the machine after a couple of weeks of energetic use was a very obvious bug — which is not connected with the hard disc — in the keyboard scanning routine. It would capture but fail to print about one key stroke in 10. This made many programs almost unworkable, but Encotel says that the problem is being remedied.

A hard disc takes a minute or so to run up to speed. If you boot too early, it may



work and it may not. This gave us a few nasty moments, when the hard disc appeared to have vanished together with its precious parcel of data. However, switching off once again and waiting for a while before booting restored matters to a proper condition.

Conclusions

- The Rodime installation in the Superbrain is neat and works well.
- It gives greatly increased storage and speed, and would make a very desirable personal computer. A 12Mbyte version is on the way, and on the horizon Rodime and other manufacturers are talking about 50 to 100Mbyte systems.
- We ran the machine for only a fortnight so we can say nothing about long-term reliability.
- Back-up is still a problem. However reliable a hard disc is, I would not be happy using it without some simple method of back-up. The prospect of shuffling a couple of dozen mini-floppies every evening does not appeal.

Chris Bidmead found that the compiled variant of this powerful Basic dialect increases its speed and security while retaining the programming flexibility of the slower, interpreted version.

Compelling of MBasic's

IN THE BEGINNING, that is the mid-1970s, an Arizona software house was supplying a small but handy, cassette-based Basic interpreter to companies like Exidy, Radio Shack and Apple. As the micro-computer momentum grew the firm grew too, and so did its Basic.

The modest 8K package grew into a larger disc version, which went on to become the extended disc Basic that is now as much a standard piece of silicon furniture as CP/M itself.

In 1980 Microsoft released a package that enabled MBasic source code to be crunched down to .Com command files that would run independently of the interpreter. In theory, at least, this gave Basic programmers a big advantage over the Cobol and Fortran fraternities, namely the luxury of interactive development under the relatively slow interpreter, with the opportunity to produce fast stand-alone programs as a final product.

The MBasic interpreter takes the source code a line at a time, then does the necessary computation by calling the big bundle of subroutines it keeps standing by in core memory. In addition to knowing how to unravel the English-like code you have written, this run-time package must contain all the routines to do anything the language will allow.

Pre-processing

Microsoft's 1980 release was a compiler. Whereas the interpreter crunches the source code at run-time, the compiler goes to work on the source code in a series of separate stages that must take place before the program can be run.

At first pass the compiler package produces relocatable code, so called because all its addresses are stored as relative rather than absolute quantities. This way the code postpones having to define where exactly in memory it will be placed before it is run.

In the second pass, when the proper computations are done on the addresses, the linker patches together this relocatable code with similarly structured standard routines borrowed from the MBasic standard library. The result is a single, coherent program.

Compiling and linking take time and trouble. The compiler is also expensive — somewhere around £200 on top of the cost of the interpreter — but its chief advantage is speed. In contrast to the purpose-built code the compiler produces, the interpreter is a time waster.

If you had some horrendous number-

crunching program that would take 100 hours to run under the interpreter, the compiler might be able to reduce this to 10 hours. This does not apply to programs that have to hang around for real-world devices like discs. In a program which keeps the discs spinning as it sorts names into alphabetical order, for instance, compilation will not shorten the run-time.

Security problems

However, compilation has other advantages. Interpreted source code can be read, its cosmetics altered, and the package resold by the software pirate. Although MBasic interpreter from version 5.2 anticipates this problem by allowing you to set a /P, Protection, switch when you save, to prevent the user listing the file, Lifeboat Associates now markets Unlock. This is described as "a development tool for the Basic programmer". What it does is unravel protected MBasic code.

Compiling, on the other hand, really can prevent what the copyright notices call "unauthorised access". Although compiled code is not entirely immune to the determined unraveller, it takes so much time that anyone with the knowledge necessary to disassemble it would probably be better off rewriting the thing from scratch.

A professional software house might use compilation to keep the code away from the user for another reason. If it sells a program for grown-up money it is going to be expected to support it. Support implies systematically collecting bug reports, issuing revisions and dealing with the odd one-off mysterious crash. This process is hair-raising enough without the suspicion that users may be reporting faults on code they have tweaked in the privacy of their own workplaces. Electrical-goods manufacturers like to seal their products with the notice "No user-serviceable components beyond this point". Software houses are following their example.

Simpler for users

Compilation has an advantage for the customer too. It is possible to configure an interpreted business system with CP/M's Submit facility so that the user simply types Run Accounts. Many modern CP/Ms now offer an autoboot feature that allows you to boot up directly into the program suite without having to enter anything at the keyboard. Comprehensive instructions would still have

to be given for loading the interpreter and the program separately if for any reason the turnkey version failed to work.

A compiled program presents a simpler face to the non-computing user. And even though the latest version of the compiler does require a few odd bits and bobs in addition to the .Com file, these are more or less invisible to the user.

The MBasic interpreter takes up a lot of space in the machine, limiting the amount left available for the program itself. Because the compiler has an opportunity to digest the source code in chunks larger than single lines it is able to do a certain amount of optimising, and having "seen" the whole program before run time, it knows to leave out routines that are never going to be called.

More compact

Well-designed compiling systems search a large library file and pick out only those routines that the programmer's code calls for. So although a run-time package of subroutines still has to be appended it is likely to be more compact than its interpreter counterpart.

Compilation lets you write bigger and more useful programs in the same space as simpler interpreted code. What happens if you are taking advantage of MBasic's unique facility to debug code prior to compilation, by running it interactively with the interpreter? How can you compile programs larger than the interpreter can handle?

The MBasic compiler has borrowed a trick from the up-and-coming Bell Labs language C. The compiler allows a %Include instruction that will pull in code from a defined file and process it exactly as if it were part of the current source file. Once you become reasonably proficient at manipulating the compiler and designing your code in modules, as the structuralists recommend, you can soak test your subroutines separately in interpreter mode and patch them all together at the moment of compilation.

The linking of .Rel files is a technique derived from Basic's predecessor, Fortran. Any .Rel file can also be produced from assembler code, and the facility for doing this — an assembler called Macro 80 (M80.COM) — is thrown in as part of the MBasic compiler package. By this means chunks of assembler code can be incorporated into your MBasic routines, providing an extremely powerful extension to the language.

Macro 80 is one of the most comprehensive 8080/Z-80 assemblers we

rtues ompiler

know, but recent graduates from MBasic interpreter should not be deterred by the weight of the manual. Learning to write short bursts of assembler requires nothing more than patience and the ability to think like a chip — simple, pure thoughts that would not strain the understanding of your average eight-year-old. M80 is packed with facilities to make all this even simpler, but unfortunately they are rather complicated to explain.

Call routines

As in the interpreter, external code can also be reached from Basic through the Call statement. For example,

```
CALL ZAP(A,B,C)
```

transfers execution to the memory address given by the variable Zap, with arguments A,B and C, all of which must have been assigned values earlier in the program. In the interpreter an absolute value will have to be assigned to Zap in a previous line, but the compiler expects Zap to be a global symbol set up by some other chunk offered up to the linker. So to compile a program that calls an absolute location such as a CP/M routine you will have to link in a small assembler patch along these lines:

```
PUBLIC ZAP ;declare ZAP
;globally
ZAP: EQU 33423 ;the address of
;the code start

END
```

or of course the code you are calling could always be written directly in the assembler from the label Zap onwards. The USR facility can be made to do the same sort of job, but it is really only there to provide upward compatibility with the cassette-based 8K version, and is best avoided.

The linker, L80, is the same program supplied with Microsoft's other two main languages, Cobol-80 and Fortran-80, so it is possible in theory to write code in any of these languages and link it all together to form a single running program. In practice parameter passing tends to become difficult across languages, so you will probably stick to pure Basic, with the odd machine-code routine thrown in.

Your early attempts at compiling will be discouraging. You have written your program in the MBasic interpreter, and it works. To run it through the compiler the simple CP/M command level instruction

```
BASCOM = <yourprog>
```

will do the trick if you do not want to change any of the defaults.

Some options can be added to the command line such as

```
/O — use the original version of the library at
Link time
/Z — write Z-80 code wherever possible
/D — include extra debugging and error handling
code
```

Discs will whirr, and then a sinister line will appear on the screen saying:

```
37 Fatal Errors
```

or words to that effect. Even when you become proficient and manage to write programs the compiler does not balk at, the compiler will still close with:

```
0 Fatal Errors
```

reminding you that you only just got by with it that time.

The grudging approval of the compiler is no guarantee that you are home and dry with a runnable program. The linker has its own criteria to fulfil: in particular it has to find a subroutine in the library, unless you supply it, to match the name of every function your program is trying to evoke. Called globals, because unlike local names they are known and understood outside the parish of each individual chunk of code you are linking, these are the rivets that stick the whole thing together.

The linker will throw up the names of those that do not match. So when you get an incomprehensible screenful of

```
UNDECLARED GLOBALS
```

do not think your computer is just being insulting.

If you come to it from the Basic interpreter, the whole process will strike you as quite time-consuming.

On ordinary 8in. discs a compilation and a link of a moderately sized program may take 10 minutes while it creates the necessary symbol tables, writes them back to temporary files on the disc and updates them. With mini-floppies the process can take even longer, although one of the new mini-Winchester devices may trim the time to no more than a minute or so. To make any substantial program work you will probably have to go through the compilation/link process several times to iron out the bugs, at least until you get to know the compiler's little idiosyncrasies.

In principle the interpreter and the compiler are the same language, but in practice there are small but important differences. Obviously the compiler has nothing to do with the interpreter's Immediate mode, and the Edit command is out, along with Auto, New, Renum and Save. Another difference that should not raise an eyebrow is the compiler's refusal to deal with lines longer than 128 characters, whereas the interpreter can cope with 255. The compiler limitation refers to physical lines, and once you advance to the stage of writing long logical lines you will have learnt how to format them properly into short physical lines using the line-feed character.

Some versions of the interpreter are reputed to support constructs such as

```
400 FOR I = 1 TO 10
```

```
410 FOR J = 0 TO 5
```

```
....
```

```
450 NEXT I
```

```
460 NEXT J
```

which the compiler sensibly throws out, and a similar restriction applies to While-Wend. The careless rapture of jumping into the middle of both sorts of loops with a Goto, permitted in the interpreter, is also beneath the compiler's dignity. If you insist on writing code like this you will have to stick to the interpreter.

Arrays will have to be declared statically. If you have found it handy in the interpreter to be able to say

```
10 IF BIG THEN A = 20 ELSE A = 10
```

```
20 DIM BUFFER(A)
```

you will have to do some rewriting. The compiler has to set aside space in the .Rel file to accommodate the array, and cannot wait till run time to know the dimensions. For similar reasons Erase will no longer let you scrub out an array prior to redimensioning. The line containing the Dim statement must physically precede the use of the array; you cannot, as in the interpreter, tidily collect all your Dim statements into a subroutine at the end of the program.

Where the difference can become annoying is in the input/output routines. You may have discovered in the interpreter that an empty carriage return in response to a line like

```
20 INPUT A$
```

loads an empty string in A\$, i.e., puts A\$ = "". This is handy in a routine like menu selection, where you can offer a series of options

```
ENTER "A", "B", "C" OR "D"
```

or let the user fall back on a default by hitting carriage return.

Still waiting

The compiled version of the code responds to a carriage return by waiting for the string it was promised. One way out is to abandon the use of Input altogether and employ Input\$(n) instead. If n is greater than 1 you and your program will probably be thrown by the fact that back-spaces entered by the user to correct mistakes in the input count as characters.

It is simpler to use Input\$(1) — some versions allow Inkey\$ — and write a small routine that catches back-spaces and unwanted control characters. An editing input routine like this would be worth considering as an assembler module, to be linked in as a .Rel file.

Writing larger and larger packages will eventually bring you up against a particularly infuriating feature of the package: a program that runs under the interpreter and has been compiled without errors may come unstuck with L80 because your .Rel files are bigger than the available memory.

The only way out of this is Plink, a

(continued on next page)

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providential package available from Lifeboat Associates. Plink can link files larger than memory by winding them on and off discs, so the size of the files it can deal with are limited only by the disc space at your disposal.

With the release of the new compiler it may not be necessary to write files this big. In MBasic it has always been particularly easy to Chain files, so that a complete business system can be built up out of a series of sections, each one a self-contained Basic program. This is the ideal way of structuring Basic programs.

Unfortunately the old version of the compiler lacked the facility, available in the interpreter, of passing values from program to program through variables designated as Common. The alternative method of communication between modules was by temporary data files, although the disc accesses that this implied necessarily slowed the program down.

New version

The new version of the compiler takes a big step forward. An early code line will list the variables whose values are to appear identically in the Chained and Chainer programs:

```
100 COMMON A, WEEKSPAY, N,
EMPLOYEES()
```

and the job is done. The same statement must appear in all the programs that are supposed to be tapping into these values and the variables must be listed in the same order.

With a large program the designation may run to several program lines. In this case the burden of the clerical work can be lightened by making use of the %Include instruction. The Common statements can comprise a separate small file, called Comdef.Bas, or whatever. This file is then written into every file interested in the variables if each of them carries

```
??? %INCLUDE COMDEF.BAS
```

where ??? represents any line number that precedes the first executable statement.

The bad news about this new version of the compiler is its size. Instead of having the Basic .Rel file pick out only the subroutines it needs from the Bascom library, which takes quite a lot of time during the link run, Microsoft has bundled the more commonly used routines into a discrete run-time file called BRun.Com, which every compiled MBasic program will now have to pull into memory as its first act of office. BRun.Com is 16K in size. However short your program, it will always occupy at least that much memory.

Because Basic does not allow subroutines created by the user to be called by name, and because of the limitations in passing parameters to those routines, Basic compiler writers try to soften the

	Interpreter	New library	Old library
Compile	N/A	25s.	25s.
Link	N/A	1min. 20s.	1min. 55s.
Run time	46s.	20s.	20s.
Disc size	2K	2K	10K
Mem size	28K + D	16K + D	10K

Table 1. Performance of test program under interpreted and compiled MBasic.

rough edges of the language by offering more and more built-in statements and functions. BRun.Com is an admission that the inclusion of the Chain with Common facilities has made the Baslib library unmanageably large.

The idea of a separate run-time package is not new. CBasic has it, as do some of the Pascals, notably Pascal/M. But Bascom ingeniously does its best to make the extra file invisible to the user. Whereas the traditional CBasic user has to prefix a call to CRun2 before the reference to the program he wants to run, the MBasic machinery is set to make the calling of the run-time package automatic when the program name is fed to CP/M's command line.

The only difficulty arises when the user program finds that BRun.Com is not on the expected disc. The location of BRun.Com has to be defined at link time, and the linker reads it from a small text file called BCLoad.

Time saved

The invisible machinery is fine for substantial programs, especially for dealing with a series of programs that Chain each other. The bulk of the run-time package stays put and the application programs are overlayed in the memory area above it. The library does not have to be called in from disc each time a new program is brought in, and disc transfer time is saved.

Nonetheless the whole arrangement is rather cumbersome for the sort of short and sweet programs that Basic does best. For this reason Microsoft includes on the release disc a copy of the old version of the compiler library, now renamed Obslib.Rel. Obs does not stand for "obsolete", indeed the old library is still an important part of the development package. The code it creates takes less memory, and will run independently of any outside help. What it will not do is support Chain with Common.

To check the mechanism we took a short test program:

```
10 DEFINT K: DEF SNG B
20 PRINT "START"
30 FOR K = 1 TO 5000
40 B = K/K
50 BB = K*K
60 NEXT K
70 PRINT "STOP"
```

and put it through the mill in three different ways as shown in table 1. These timings are obviously hardware dependent, particularly as the compile and link figures include the time taken to pull the

systems files in off our rather slow Micro-polis 5.25in. discs. The third row gives genuine computation time, taken from the program's Start and Stop prompts, and you will see from this that compilation gives an improvement of 130 percent. Run timings are identical between the old and new libraries, but the improvement in link time, even for this small program, is very noticeable.

Memory space

The disc-size row reflects the fact that typical mini-floppy implementations of CP/M try to improve disc speed by refusing to deal with memory transfers below a certain minimum, the block size. The actual size of the test program in memory under the interpreter is trivial, designated in the last row of the table as D. Most of memory in that case consists of the 28K of the interpreter.

Similar remarks apply to the program as compiled with the new library: the bulk is taken up by the 16K BRun package that must co-reside in memory. Notice that the total compiled size is larger under the new system; the 10K in the last row shows that the linker has selected only those routines associated with the test program.

As with all benchmark tests, the language comprises more than the two statements tested in this program so be cautious with the run-time figures. Change the program lines:

```
40 B = K*.5
50 BB = K*3
```

and you have a program that runs at 5 minutes 20 seconds whether you compile it or not.

Conclusions

- The MBasic compiler package can be used without the interpreter, the programmer writing the source code as an ASCII file.

- Probably the best use of the compiler is in crunching down Basic programs developed under the interpreter. Used like this the whole MBasic5 package makes a very powerful program-development system.

- The new version of the compiler lets you create a complete suite of programs that pass values from one to the other. Very sophisticated business software can result, as there is now virtually no limit to the total size of the code.

- The bad news is that Basic is still Basic. It is worth repeating that a language should help you think about the problem, as well as code it.

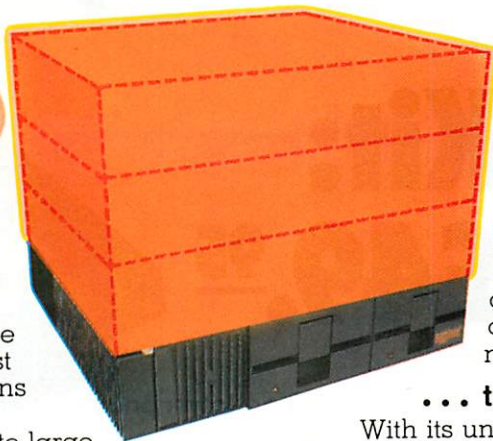
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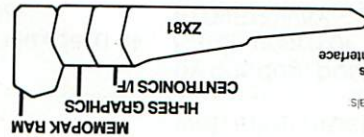
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From simple arithmetic to A-level chemistry

THE MICROELECTRONICS Education Programme offers some Government support to authors of educational software, but equally important from the publisher's point of view supports teacher training and awareness in the application of microcomputers in education. This is likely to create a larger market, making it more profitable for publishers to enter this area.

A few publishers have already taken the plunge. One of the first to do so is Longman, already well established in the educational book market, who last year announced a proposed micro software series. Two of the earliest packages available are Chemdata and Janeplus, both available in disc and cassette versions for the Pet and RML 380-Z initially.

Chemdata is aimed at those teaching chemistry to GCE A-level and provides graph-plotting facilities on the first 38 elements of the periodic table. Chemdata may be used either to teach a whole class or by individual students, although it is perhaps more suited to the former.

Simple plotting

The program stores information related to the following: atomic volume, melting point, boiling point, ionisation energy, atomic radius, oxidation states, group numbers, enthalpy of fusion and enthalpy of variation, any of which may be chosen to form the vertical axis. The horizontal axis may be atomic number, transition metals or a group. It is easy to plot the graphs using simple commands, and equally easy to change either or both of the axes. Facilities for printer output are provided to give hard copy of the graphs or the data file.

A useful command available at any time is Help which provides a list of the commands available. The program is carefully designed so that the user is unlikely to find any real difficulties while running the program, although it is advisable to read the brief but clear guide and running the program.

The review copies supplied were on cassette for the 380-Z and disc for the Pet. The 380-Z version plots points on the graph in low resolution; the Pet version draws vertical lines, the height of which represent the values to be displayed. Both versions have to approximate the values to be represented, because of the screen graphics used, but the errors on the Pet screen are more noticeable, in some cases displaying zero as one character on the screen.

The scaling, particularly of the vertical axis, is poor to the point of obscurity,

Publishers have traditionally been unwilling to risk producing software for schools. Now Michael Trott asks if 1982 is to be the year of educational software.

displaying only upper and lower values with no intermediate markings.

The printed material consists of a manual which provides details of the design and structure of the program, including subroutines and variables and a full listing of both versions which is clearly explained section by section. The manual also explains how to add routines to the program and must be regarded as a plus point in Longman's favour. A running sheet is also provided for novice users, giving clear instructions on loading for the various versions available.

A teacher/student booklet gives details of the facilities available in the program and a short study guide.

The program is reasonably good value for money and is attractively packaged. However, the facilities of the program are rather limited and a colleague who has taught A-level chemistry for some years and is a keen micro user was not particularly impressed.

Janeplus is aimed at a wider ability and a five-to-18 age range. It is designed to be used by the teacher with groups or individual pupils to encourage children to discuss simple mathematical functions. The program draws small figures on the screen, who change numbers in accordance with the function in question. The teacher then uses this as a basis for class discussion.

There are a number of characters in Janeplus, each of which represents a different function, for example, "add 7" or "multiply by 3". The user may choose a one- or two-function problem from these characters.

A typical run through the program might start with two boxes appearing on the screen with a character called Peter between them. The children are then invited to "give Peter a small number". The answer could then be displayed by pressing A, when Peter appears to transfer the number given to him from the left-hand box to the right, changing it in some way. The children would then be asked to suggest what Peter's function is, i.e., what he has done to the number. From the answers suggested, the children can then proceed to narrow down the possibilities by giving Peter further numbers. When an answer has been agreed

upon it can be checked by giving Peter another number and entering the children's answer. If they are correct the right-hand box is enclosed in stars and a bell sounds if a printer is connected.

Single functions can be used to investigate either addition or multiplication, and two-function problems present a combination of these. By using the inverse situation, subtraction and division can also be examined. The girl characters multiply and the boys add and in each case the range of integers to be used may be selected as between +2 and +6 or -6 and +6. The program provides opportunities and stimulus for class discussion, and pupils responded well to the program.

The teacher's handbook is very clearly set out, providing details of the program and the decision points, observations in the classroom as well as general advice to the teacher. A program listing is also provided with a summary of the drive-chart conventions. The concept of using drive charts was developed by the ITMA project based at the College of St Mark and St John in Plymouth and has been incorporated into a number of programs from that source. Programs from ITMA have been tested and developed in schools.

Teachers' introduction

A program called Testdrive is supplied with Janeplus. It is an excellent and amusing program intended to familiarise teachers with the use of drive charts by calling up one of three animals: Claude the cat, Wilfred the wolf or Katie the kangaroo. These animals can then be made to wink an eye, wag a tail and move off the screen, using single-key commands. The program, which comes with an accompanying booklet, provides a really excellent means of introducing the novice teacher to the use of a micro for teaching, thanks to the use of drive charts to run the program.

Conclusions

● Chemdata and Janeplus each cost £12.50 on disc and £9.50 for the cassette version.

● Chemdata is attractively packaged and represents reasonably good value for money, though its facilities are rather limited.

● Janeplus is excellent value for both junior and lower-secondary schools. The program provides ample variety to hold children's interest, and is robust and reliable.

IF YOU LIKE problems to be so subtle as to verge on the insoluble, a good way of spending the best years of your life is to concentrate on a problem in the field of natural language. Any problem in the field will do, since natural language — English, for instance — is something we all know well while being unable to say exactly how we know it.

That is the essence of the matter as far as computers are concerned. A computer usually has to be told exactly what to do in order to do it. When you learned your native language you were not told how to do it.

All that can usually be said with any attempt at concreteness is that people seem to have a language-acquisition mechanism — LAM, as it is usually called. The LAM somehow enables them to learn a language simply by being exposed to it, rather than by being programmed with specific rules for that language. So you can learn English at a very early age. You could have learned German or even Chinese using the same mechanism.

Your computer is rather different. In all the time you have owned the thing, it probably has not learned a single word, no matter how much you shouted at it. A human infant receives language as a stream of sounds. Sounds which are unfamiliar at first become more familiar as time progresses. From these sounds the infant has to join together words one to another if they make phrases.

The infant is receiving what is known as continuous speech, a solid input stream, unmarked at word boundaries. You can give your computer the same input. To avoid complications — after all, this is only a demonstration — give the machine text rather than audio input and present it in a solid stream. For instance, "present it in a solid stream" is input as PRESENTINASOLIDSTREAM

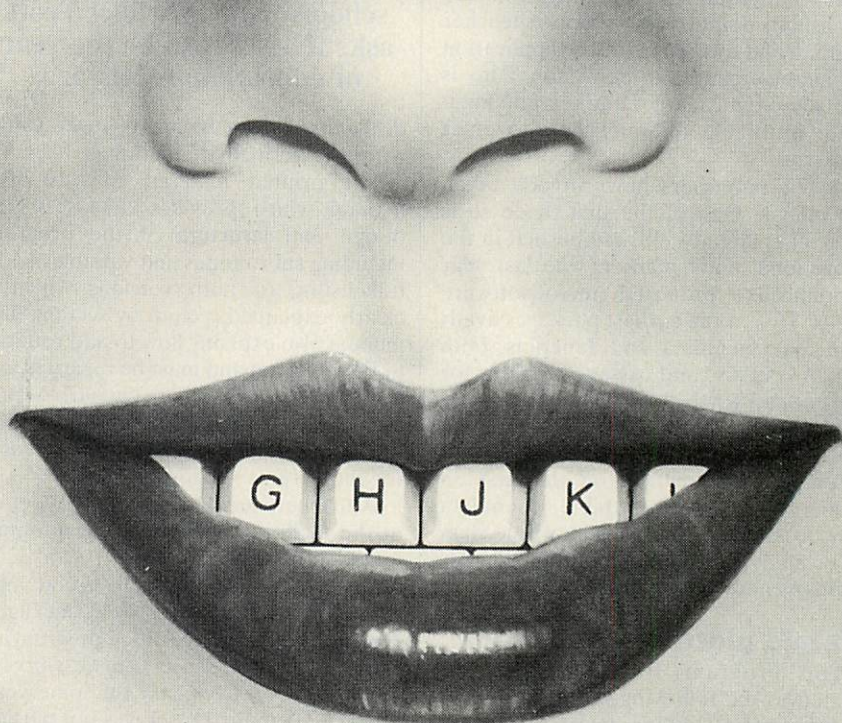
which should give you some idea of the problem facing the infant. It is much harder to read with no spaces or punctuation in it. Equally, continuous speech is hard to disentangle when the beginnings and endings of words run into each other.

Your computer now has something to work on which approximates to continuous speech. In its memory you put nothing that will tell it what the words of the language are, or even what the letters are. It has to work that out for itself.

The computer now has to "listen" to a stream of this text and learn the language by doing so. It does this in two ways:

- By scanning the text and noting all the different elements in it: at first these are just the letters of the alphabet to which it is exposed. You do not give it an alphabet to start with, and it does not learn the alphabet all at once, but only as new letters come along.
- By scanning the text and choosing a pair of elements which it thinks go together. When it finds such a pair it adds them to the lexicon as a new word which it has "learned".

Famous first words



**Can computers acquire language naturally?
Chris Naylor's simple program takes a few
faltering steps towards eloquence.**

Figure 1 is based on the text "it is sunny", which has been turned into a continuous stream "ITISSUNNY" and input to the machine. On input, the program gradually builds up its own lexicon to contain I, S, T, U, N and Y. The program registers in the matrix what letter combinations occur, and the frequency with which they occur.

In this short example no combination occurs more than once, so each element of the matrix contains 0 or 1. With a larger sample, higher-frequency combinations would normally be present.

The program now has to decide which pair of lexicon items can be added together to create a new lexicon item. Having made this decision the lexicon is incremented by one item and the matrix rearranged. Figure 1 shows the arrangement if "it" were to be selected as a word. T disappears from the lexicon, as it ceases to be an item which occurs by itself, and IT is added. The matrix is rearranged to present the new letter combinations considering IT as a letter all by itself.

Programming this much is fairly straightforward. The difficulty lies in choosing which letter pair — in general which pair of lexicon items — to join together. Three types of decision can be made:

A wrong decision: for instance, TI, which is wrong because in this example TI only occurs at a word boundary, not within a word.

A right decision: for instance, IT, which is right because in this example IT only occurs within a word.

An ambiguous decision: for instance, TI, if the text also contained the word "time". It would be ambiguous because it could occur either within a word or at a word boundary.

With extremely large text samples almost all elements would appear to be ambiguous so the problem would appear, initially, to be academic. However, whereas all the elements may be ambiguous, some are still more likely to occur within words than at word boundaries and consequently some make better selections than others. For instance, if the

Figure 2. Original text.

It is summer time. School is over, and the long summer holiday is here.

Jane and Peter talk about their long summer holiday, and what they are going to do.

"I like school," says Peter, "but I am glad the holiday has come."

"Yes, I am glad too," says Jane. "I like sunny days when we have no work to do. There are so many nice things to do in the holiday when it is sunny."

"Yes," says Peter, "and Dad thinks it does us good to get out in the sun. We will be out every day when the sun comes out."

"Do you know there is an old donkey up at the f

Figure 3. Input text.

ITISSUMMERTIMESCHOOLISOVERAND
THELONGSUMMERHOLIDAYISHERE
JANEANDPETERALKBABOUTTHEIRLONG
SUMMERHOLIDAYANDWHATTHEYARE
GOINGTODOILIKESCHOOLSAYS
PETERBUTIAMGLADTHEHOLIDAYHASCOME
YESIAMGLADTOOSAYSJANEILIKE
SUNNYDAYSWHENWEHAVENOWORK
TODOTHEREARESOMANYNICETHINGS
TODOTHEHOLIDAYWHENTISSUNNY
YESSAYSPEERANDDADTHINKSIT
DOESUSGOODTOGETOUTINTHESUN
WEWILLBEOUTEVERYDAYWHENTHE
SUNCOMESOUTDOYOUKNOWTHEREIS
ANOLDDONKEYUPATTHEF

Figure 4. Analysed text.

HE	DO	
THE	SUM	SAYS
HO	SUMME	SC
AY	RE	SO
AN	SUMMER	IT
LI	IN	JAN
HOLI	HEN	HIN
HOLID	ER	VER
HOLIDAY	TODO	SCHO
ME	HA	LIKE
SU	PE	SAYSPETER
UT	PET	SUMMER
AYS	PETER	HOLIDAY
TO	IS	ITIS
SUN	WHEN	JANE
AND	KE	

program chose TI early on, it would have a hard job choosing the words "it" and "is" when they occur together. Every time the machine sees "itis" it assumes the segmentation I TI S. The pairs of elements IT and IS are removed from the matrix when TI was formed.

In order to be able to choose which items to join together, the program has to have some information about them. There must be variables associated with the various combinations. However, like a new-born infant, the program knows nothing about the letters themselves — it only knows what it can build up from experience. Obviously such information must be independent of any particular language, otherwise the program could only learn that one language.

Frequency information is available independent of the particular language, and the following variables suggest themselves:

- frequency of occurrence of each combination, A

- frequency of occurrence of the first item in the combination, B
- frequency of occurrence of the second item in the combination, C
- number of items with which the first element occurs, K1
- number of items with which the second element occurs, K2

In the example, IT has A=1, B=2, C=1, K1=2, K2=1. We can then choose which pair to select from the equation.

$$FF = B1 \cdot a + B2 \cdot b + B3 \cdot c + B4 \cdot d + B5 \cdot e$$

B1 to B5 are numerical coefficients and a to e are transformations of the variables derived from an analysis of large samples of text. They are shown in table 1. I, J are the rank order of B and C respectively, and SL is the sum of the rank orders. Thus if B is the most frequent first element it has the rank of 1. The least frequent first element will have the rank LC — the number of items in the lexicon. SL clearly has the value $1+2+3+\dots+LC$. The pair is chosen to give the greatest value for FF.

Figures 2 to 5 show how the program learns words from small samples of English and German text. A simpler mechanism can be used which just works on the basis of selecting the most frequently occurring pair of items each time the program examines the matrix. This can be useful when writing the program to make sure that all of the other parts are working correctly.

Figure 2 contains the first 400 characters from a Ladybird children's reader, *Sunny Days*. The end may seem a little abrupt, but that is the result of arbitrarily deciding to see what happens with 400 characters.

The text is presented to the language-acquisition mechanism with all spaces and punctuation removed, as in figure 3, to simulate continuous speech. The LAM produces a series of segments, in the order shown in figure 4, which are then added to the lexicon.

Though the machine acquires some units of language, it does not find all of them. It finds some which have occurred in the small amount of text it was given, plus a few segments which do not appear anywhere in the text but still happen to be words, e.g. HE, ME, etc. The mechanism has taken a very small amount of text and tried to squeeze as much out of it as possible.

This short demonstration gives some idea of the robustness of the technique, but in practice, the program would be given a threshold level of certainty. It would not form a new segment unless it was sufficiently certain that it was one it wanted. Lacking such certainty, it would simply continue inputting new text until it had sufficient information to make a more certain judgement. It would learn more slowly, but more surely.

You might pause to consider what you would make of 400 characters of unsegmented text in a language you had never

seen before. Viewed in that light, perhaps the machine does not do too badly.

One factor which favours the existence of a language-acquisition mechanism in humans, rather than an innate knowledge of language as such, is the commonplace observation that a human infant learns with equal ease whichever language it happens to be exposed to. So if the computer's language-acquisition mechanism is anything like the human one it should be able to learn foreign languages without any difficulty.

One problem in testing this hypothesis is that different languages use different alphabets. German, for example, uses Ä, Ö, Ü and ß — which approximates to the sound "sz" — in addition to the 26 letters of the English alphabet. On most computers, numerals or graphics characters must be used to represent these.

The segments generated from 400 words of German continuous text are shown in table 5, about 25 percent of which are genuine German words. That this is not as good a performance as it produced in English may, in the absence of further evidence, be due to the nature of the German language, or to the characteristics of the particular passage which was chosen. Nevertheless, it demonstrates in principle that a mechanism could be devised which would enable a computer to learn a fair amount about a language simply by being immersed in it.

(continued on next page)

Table 1.

B1= 2.407	a= log(A)
B2= 18.431	b= 1/SL
B3= .1123	c= J/SL
B4= 1.184	d= log (LC+.5 -K1)
B5= .8004	e= log (LC+.5 -K2)

Figure 1.

LEXICON

MATRIX

	I	T	S	U	N	Y
I	I	0	1	1	0	0
T	T	1	0	0	0	0
S	S	0	0	1	1	0
U	U	0	0	0	0	1
N	N	0	0	0	0	1
Y	Y	0	0	0	0	0

If "IT" is selected as a new word we have:
(IT) ISSUNNY

LEXICON

MATRIX

	I	S	U	N	Y	(IT)
I	I	0	1	0	0	0
S	S	0	1	1	0	0
U	U	0	0	0	1	0
N	N	0	0	0	1	0
Y	Y	0	0	0	0	0
(IT)	(IT)	1	0	0	0	0

(continued from previous page)

A system of this kind, particularly one which could run on voice input would offer certain advantages. You would not need to program in the "rules" of the language in advance, and you would not have to specify the vocabulary in advance. The machine would build up its own vocabulary and understanding.

If a workable recognition process could be devised, it would have less difficulty with continuous speech than programs which give the computer a prior definition of each word in speech since the machine would have learned its vocabulary from continuous speech. It would, therefore, learn language as it is spoken naturally rather than as it is defined formally.

Beyond pure form

This approach has yet to be tested in the field of natural languages. Certainly, it holds more promise than pretending that natural languages are just very complicated formal languages analogous to a super-high-level computer language.

The Language program was developed as a simulation of human language acquisition. It is able to select nouns and other fairly "central" words in preference to less directly meaningful items from continuous text. Foreign languages suit it just as well as English.

Given the raw elements on its input, it is a method, specifically expressed as a formula, for starting to acquire a language.

To derive the central equation of the program, a large sample of text was analysed. It was assumed that people, like the program, had to be able to join together separate items as a first step in learning any language. The equation in the program defines a mechanism which would

Figure 5. Analysis of German.

ER	ES	IH
TE	SIE	IM
HER	KA	IMM
AR	HERRM	IN
HERR	HERRMÜ	ING
ND	HERRMÜL	IT
UND	HERRMÜLL	EN
IE	HERRMÜLLER	ÜB
WAR	DER	ÜBER
BE	ZU	ÜBERZIEHER

be likely to acquire the language analysed in the samples.

Over a long period of time, so one theory goes, people have developed their language and reduced it to written form. Their children have been able to acquire this language and have continuously modified it. That being the case, you expect language to be easy for a human infant to learn and to evolve to become even easier. The easiest parts to learn would be those with the highest survival value.

The precise meaning of "easy to learn" is not easy to define. It makes sense to think that language has evolved to match the mechanism which acquires it, and that the mechanism which acquires it has evolved to match the language available. The result is that, quite naturally, an image of the acquisition mechanism must lie somewhere in the properties of the language itself. The properties of the human acquisition mechanism should contain clues for a machine language-acquisition method.

At first sight such a mechanism appears to be of academic interest only. Yet suppose you have an office with memos and reports flying around it. You engage a new filing clerk, who drifts up to you one day with a piece of paper and asks where it should be filed. You look at the paper

and pronounce accordingly. After a while the clerk begins to get the idea and calls out that a given piece of paper seems to be about, say, holidays. Well, you explain, file it under Recreations.

Now transfer that to machine. All of the memos are on disc and they need filing, categorising, call it what you will, so that various people have access to particular documents or have copies printed for them or, at any rate, the memos are actioned in some way.

How do you decide what action to take? The filing clerk has gone and you are reduced to either specifying all the key words in advance, or reading all of the documents in order to build up the key words.

Sensitive to meaning

A computer could help you by scanning the documents and presenting you with a list of all the different words used. This would enable you to specify key words without having to read all the files, but it is still a considerable effort.

Yet if the language-acquisition technique is used, the system no longer needs to learn words as such because all of that information is present in the segmented text. Furthermore, the mechanism works by learning words in a particular order much as a human observer might. It tends to be picking on those words with the highest "meaning" in the sense of the most concrete terms.

This mechanism could be used to scan documents intelligently, asking about only those words which strike it as "interesting" and asking the operator what to do when it encounters such a word. Subsequent recognition of these words would be easy with normally segmented text, and the operator's response could be

(continued on page 77)

Static run listing without recogniser.

```

10 HOME : PRINT "LANGUAGE":
11 H1 = 1.184015211H2 = .0004171
67:H3 = 18.431053751H4 = .11
2255309:H5 = 1.625639319:H6 =
1.475639897:H7 = .5
20 W = 1:XT = W:TW = 2:TH = 3:T =
100:TT = 1000:EI = 8:ML = TW
THI = WHJ = W:TC = TT:TY =
36:CI = B1 + B2 + H5:CC = TW
+ (B1 + B2):TS = TT
30 REM :S(C) HOLDS THE 1/P STRIN
B(L,C) HOLDS THE LEXICON, PL
X(C) HOLDS LEXICON FREQUENCIE
S.
40 REM :THIS SECTION TAKES IN TH
E 1/P STRING AND BUILDS UP A
LEXICON AND FREQUENCY COUNT
50 DIM S$(2000),L$(T),PLX(T),LX(
T,T),XX(T),I(T): DEF FN KM
(A) = SGN(A) - W: DEF FN
KP(A) = W - SGN(A - W)
60 INPUT "HOW MANY CHARACTERS AR
E YOU ENTERING AT A TIME ?":
SC
61 INPUT "DO YOU HOLD THE CHARAC
TERS ON TAPE ? Y/N":AS
62 IF AS = "Y" THEN : PRINT "REC
ALL X*": STOP : FOR I = W TO
SC:S$(I) = CHR$(XX(I)): PRINT
S$(I): NEXT I : FOR I = SC +
W TO TT:S$(I) = CHR$(XX(I)
): NEXT I : GOTO 95
79 FOR I = W TO SC
80 GET S$(I):XX(I) = ASC(S$(I)
)
81 IF ASC(S$(I)) = EI THEN I =
I - W:S$(I) = "": PRINT I : PRINT
: FOR J = W TO I - W: PRINT
S$(J): NEXT J : GOTO 80
90 PRINT S$(I): NEXT
91 PRINT : INPUT "DO YOU WISH TO
STORE THESE CHARACTERS ON T
APE ? Y/N":AS
92 IF AS = "Y" THEN : PRINT "STO
RE X*": STOP
94 REM :THE NEXT SECTION SETS U
P L(X,I,J) AS A JOINT PROBABI
LITY MATRIX.
95 HI = Z: FOR I = W TO SC
110 FOR J = Z TO LC
120 IF S$(I) ( ) L*(J) THEN : NEXT
J
130 PLX(J) = PLX(J) + W: IF J = L
C + W THEN :LC = LC + W:L*(L
C) = S$(I)
140 IF HI THEN :LX(HI,J) = LX(HI
,J) + W:LX(HI,Z) = LX(HI,Z) +
FN KP(LX(HI,J)):LX(Z,J) = L
*(Z,J) + FN KP(LX(HI,J))
150 HI = J: NEXT I: PRINT
800
160 HI = W:HJ = W: GOSUB 700: GOSUB
800
326 NX = SC - W:SL = LC + (LC + W
) / TW:NC = Z: FOR I = W TO
LC:I(I) = I:NC = NC + L*(I,Z
): NEXT I
329 FOR I = TW TO LC:IC = W:CC =
I(I - W)
330 IF PLX(I) = PLX(I - W) THEN
:CC = CC + I(I):C = C + W:I =
I + W: IF I ( = LC THEN 330
331 IF C ) W THEN : FOR J = I -
C TO I - W:I(J) = CC / C: NEXT
J
332 NEXT :D3 = LC + HF:D1 = H3 /
SL:D2 = B4 / SL:HH = TR - C1
+ LOG(NC) + C2 + LOG(LC
) + B5 + LOG(NX) + B6:H =
HH
333 FOR I = W TO LC:FA = B1 + LOG
(D3 - L*(I,Z)) + D1 + I(I) : FOR
J = W TO LC
334 IF L*(I,J) THEN :FF = FA + B
2 + LOG(D3 - L*(Z,J)) + D2
+ I(J) + B5 + LOG(L*(I,J)
) : IF FF ) HH THEN :HI = I:H
J = J:HH = FF
340 NEXT : NEXT
347 HA = L*(HI,HJ):HB = PLX(HI) -
HA:HC = PLX(HJ) - HA:H = HH -
H + TR: PRINT "COEFFICIENT F
F = "H
349 PRINT "LEXICON ADDITION IS :
"HL*(HI) + L*(HJ)
370 LC = LC + W:L*(LC) = L*(HI) +
L*(HJ)
380 IF L*(HI) ( ) X$ AND L*(HJ)
( ) X$ AND X$ ( ) " THEN
: PRINT "I SUGGEST THAT "H
383 INVERSE : PRINT X$: NORMAL
386 PRINT " IS A WORD IN ITS OWN
RIGHT"
390 X$ = L*(LC)
+LIST391,850
465 IF LEN(L*(LC)) ) ML THEN :
ML = LEN(L*(LC))
490 I = W
500 IW = 1 + W: IF S$(I) + S$(IW)
= L*(LC) THEN :S$(I) = L*(L
C): FOR J = IW TO SC - W:S$(
J) = S$(J + W): NEXT : GOSUB
900:SC = SC - W
510 PRINT S$(I): " "
520 I = IW: IF I ( SC THEN 500
530 IF I = SC THEN : PRINT S$(I)
540 PLX(LC) = PLX(LC) + HA:LX(HI,
HJ) = Z:PLX(HI) = PLX(HI) -
PLX(LC):PLX(HJ) = PLX(HJ) -
PLX(LC):LX(HI,Z) = LX(HI,Z) -
W:LX(Z,HJ) = LX(Z,HJ) - W
550 PRINT "SC = "SC
555 GOSUB 700: GOSUB 800
570 GOTO 325
700 REM :SORT ROUTINE
710 IF HJ ( HI THEN :HI = HJ
715 FOR I = W TO LC - HI:IC = Z
720 FOR J = HI TO LC - 1:JW = J +
J = J:HH = FF
340 NEXT : NEXT
347 HA = L*(HI,HJ):HB = PLX(HI) -
HA:HC = PLX(HJ) - HA:H = HH -
H + TR: PRINT "COEFFICIENT F
F = "H
349 PRINT "LEXICON ADDITION IS :
"HL*(HI) + L*(HJ)
370 LC = LC + W:L*(LC) = L*(HI) +
L*(HJ)
380 IF L*(HI) ( ) X$ AND L*(HJ)
( ) X$ AND X$ ( ) " THEN
: PRINT "I SUGGEST THAT "H
383 INVERSE : PRINT X$: NORMAL
386 PRINT " IS A WORD IN ITS OWN
RIGHT"
390 X$ = L*(LC)
+LIST391,850
465 IF LEN(L*(LC)) ) ML THEN :
ML = LEN(L*(LC))
490 I = W
500 IW = 1 + W: IF S$(I) + S$(IW)
= L*(LC) THEN :S$(I) = L*(L
C): FOR J = IW TO SC - W:S$(
J) = S$(J + W): NEXT : GOSUB
900:SC = SC - W
510 PRINT S$(I): " "
520 I = IW: IF I ( SC THEN 500
530 IF I = SC THEN : PRINT S$(I)
540 PLX(LC) = PLX(LC) + HA:LX(HI,
HJ) = Z:PLX(HI) = PLX(HI) -
PLX(LC):PLX(HJ) = PLX(HJ) -
PLX(LC):LX(HI,Z) = LX(HI,Z) -
W:LX(Z,HJ) = LX(Z,HJ) - W
550 PRINT "SC = "SC
555 GOSUB 700: GOSUB 800
570 GOTO 325
700 REM :SORT ROUTINE
710 IF HJ ( HI THEN :HI = HJ
715 FOR I = W TO LC - HI:IC = Z
720 FOR J = HI TO LC - 1:JW = J +
J = J:HH = FF
730 W
730 IF PLX(J) ( PLX(JW) THEN :H =
PLX(J):PLX(J) = PLX(JW):PLX(
JW) = H:AS = L*(I):L*(J) = L
*(JW):L*(JW) = AS: FOR K = Z
TO LC:H = L*(K,J):LX(K,J) =
L*(K,JW):LX(K,JW) = H: NEXT
: FOR K = Z TO LC:H = L*(K,K
):LX(K,K) = L*(JW,K):LX(JW,K
) = H: NEXT :C = C + W
750 NEXT : IF C THEN : NEXT
760 IF PLX(LC) = ZERO THEN :L*(L
C) = "":LC = LC - W: GOTO 76
0
770 RETURN
800 REM :PRINT LEXICON ROUTINE.
810 PRINT "LEXICON = "LC
820 PRINT "I",L*(I):" FREQUEN
CY=PLX(I)"
830 FOR I = W TO LC
840 PRINT I,L*(I),PLX(I)
850 NEXT : RETURN
900 REM :READJUST L(X,I,J) ROUTIN
E.
910 C = TW: FOR K = W TO LC
920 IF S$(I - W) = L*(K) THEN :L
*(K,LC) = L*(K,K) + W:LX(K,
K) = L*(K,K) - W:C = C - W
930 IF S$(I) = L*(K,K) THEN :B =
FN KM(L*(K,K)):LX(K,LC) = B +
FN KM(L*(K,K)):LX(K,Z) = L*(K,
Z) + B:LX(Z,K) = L*(Z,K) + B
925 IF IW = SC THEN : NEXT : RETURN
930 IF S$(IW) = L*(K) THEN :LX(L
C,K) = L*(LC,K) + W:LX(K,K) =
L*(K,K) - W:C = C - W: B =
FN KM(L*(K,K)):B = FN KM(
L*(K,K)):LX(LC,Z) = L*(LC,Z
) + B:LX(Z,K) = L*(Z,K) + B
940 IF C THEN : NEXT
950 RETURN

```


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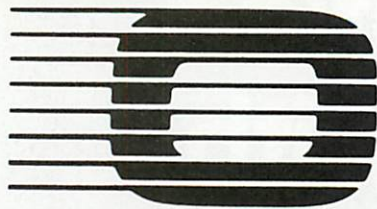


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(continued from page 72)

used to build up a job file of appropriate actions. The system would learn as it goes along and would avoid swamping the operator with queries about every little item.

The mechanism has, in some ways, a sense of attention. It does not look at things randomly, but pays attention to things which look as if they are meaningful or go together in some way. This enables it to pick out words in text as being more "significant" than others even though it does not know what they mean.

The Language program works on a string, \$\$(1000). You have to input the number of characters which the program is to consider, in the range 1 to 1000. If the string is not on tape, key it in. The programme uses Get, so the keyboard is on-line. Errors can be corrected by keying left-arrow.

When the given number of characters are keyed in they can be stored using Store X%, where X% is the ASCII equivalent of \$\$\$. Subsequent runs with the same string input can be initiated using Recall X% instead of keying.

The program then operates on the string information, producing new segmentations and displaying them on the screen together with the entire string data, with spaces inserted to show the segmentation process to date. It runs slowly, as it is designed for ease of modification rather than speed. Most of the time is spent on a time-consuming sort which is helpful for analysis.

Segments are formed according to the value of the coefficient FF. The higher the value of FF, the better. By the time FF has dropped to a value of about 3 the segments chosen may contain occasional errors; a value of 4 or more is desirable. Much of the central code is concerned with scaling FF to give a consistent range of values of FF, irrespective of the sample size chosen initially or the subsequent progress of the program. Input characters may be any valid string variable, not just letters of the English alphabet.

This method of running is a static run: the same text is worked to exhaustion without further input. A dynamic run consists of inputting further string information to the mechanism according to a given criterion. For instance, to reduce

the probability of mistakes occurring, a high threshold value of FF may be set — say, 4.5 — and a new segment will only be acquired if it exceeds the threshold. If no FF exceeds this threshold then \$\$ is searched for more input for the mechanism. As data is input from \$\$ a recognition routine may be used to identify segments within the input stream as segments previously acquired.

If N characters are input there are, in general, 2^{N-1} different ways of segmenting them, so 20 characters may be segmented in a maximum of 524,288 different ways. Fortunately, many of these ways may be excluded as containing segments which the mechanism has not previously acquired. The correct segmentation may occur along with 50 or more other possibilities after only a short run. Recognising the correct segmentation is a considerable problem.

The program runs on an Apple II with cassette recorder and 48K main memory. Disc is not needed and DOS should not be loaded. For large amounts of data all arrays may be converted to disc files or additional RAM or any other method that works.

Listing with recogniser routine.

```

10 HOME: PRINT "LANGUAGE": INPUT
  "INPUT THRESHOLD (DEFAULT=0)":
  "FF":
11 B1 = 1.184015211182 = .8006171
  B7185 = 18.43193575184 = .11
  2255309185 = 1.625639319186 =
  1.47663989718F = .5
12 INPUT "DO YOU WANT RECOGNITION
  ROUTINE? Y/N": RNR
20 W = 1: XT = W: TW = 2: TH = 3: T =
  1001: TT = 1000: H1 = 8: M1 = TW
  H1 = W: HJ = W: TC = TT: TTY =
  361: B1 = B1 + B2 + H1: C2 = TW
  * (B1 + B2): T3 = TT
30 REM: S$(1) HOLDS THE I/P STRING
  B.L.(1) HOLDS THE LEXICON. PL
  X(1) HOLDS LEXICON FREQUENCY
  S.
40 REM: THIS SECTION TAKES IN THE
  I/P STRING AND BUILDS UP A
  LEXICON AND FREQUENCY COUNT
50 DIM S$(2000), L$(1), PLX(1), L$(
  1), T, X$(TT), T(T), B$(30), TY, K
  FX(TY): DEF FN RM(K) = SGN
  (K) - W: DEF FN KP(K) = W -
  SGN (K) - W
60 INPUT "HOW MANY CHARACTERS ARE
  YOU ENTERING AT A TIME?": T
  SC
61 INPUT "DO YOU HOLD THE CHARACTERS
  ON TAPE? Y/N": RNR
62 IF RNR = "Y" THEN: PRINT "REC
  ALL XX": STOP: FOR I = W TO
  SC: S$(I) = CHR$(X$(I)): PRINT
  S$(I): NEXT I: FOR I = SC +
  W TO TT: S$(I) = CHR$(X$(I))
  : NEXT I: GOT0 95
63 FOR I = W TO SC: GET S$(I): XX
  (I) = ASC (S$(I))
64 IF ASC (S$(I)) = EI THEN: I =
  I - W: S$(I) = "": PRINT: PRINT
  : FOR J = W TO I - W: PRINT
  S$(J): NEXT J: GOT0 80
90 PRINT S$(1): NEXT
  PRINT: INPUT "DO YOU WISH TO
  STORE THESE CHARACTERS ON TAPE?
  Y/N": RNR
92 IF RNR = "Y" THEN: PRINT "STO
  RE XX": STOP
94 REM: THE NEXT SECTION SETS UP
  PLX(1, J) AS A JOINT PROBABILITY
  MATRIX.
95 H1 = 1: FOR I = W TO SC
110 FOR J = 2 TO LC
120 IF S$(I) = L$(J) THEN: NEXT
130 PLX(J) = PLX(J) + W: IF J = L
  C + W THEN: LC = LC + W: L$(LC)
  = S$(I)
140 IF H1 THEN: L$(H1, J) = L$(H1,
  J) + W: L$(H1, Z) = L$(H1, Z) +
  FN KP(L$(H1, J)): L$(Z, J) = L
  $(Z, J) + FN KP(L$(H1, J))
150 H1 = J: NEXT I: PRINT
160 H1 = W: HJ = W: GOSUB 700: GOSUB
  800
326 NX = SC - W: L$(LC) = LC + (LC + W)
  : TW = NX: Z = FOR I = W TO
  LC: L$(I) = L$(NX) = NX + L$(I, Z)
  : NEXT
329 FOR I = TW TO LC: C = W: CC =
  1: (I - W)
330 IF PLX(I) = PLX(I - W) THEN
  : CC = CC + 1: (I - C) = W + 1:
  I = W: IF I = LC THEN: NEXT 330
331 IF C = W THEN: FOR J = I -
  C: (I - W) = W: (I - C) = C: NEXT
  J
332 NEXT: D3 = LC + H1: D1 = B3 /
  SLD2 = HA / SLH1 = TR - C1
  + LOG (NC) + C2 + LOG (LC)
  + H5 + LOG (NX) + H6: H =
  HH
333 FOR I = W TO LC: FA = B1 + LOG
  (D3 - L$(I, Z)) + D1 + 1: (I) = FOR
  J = W TO LC
334 IF L$(I, J) THEN: IF FA + B
  2 + LOG (D3 - L$(Z, J)) + D2
  + 1: (J) + B5 + LOG (L$(I, J))
  : IF FF = H1 THEN: H1 = 1: H
  340 NEXT: NEXT: IF H1 = H THEN
  347
345 IF RNR = "Y" THEN: GOSUB 20
  40: H1 = W: HJ = W: GOSUB 700:
  GOT0 326
347 HA = L$(H1, HJ): HB = PLX(H1) +
  HA: HC = PLX(HJ) - HA: H = H1 -
  H + TR: PRINT "COEFFICIENT F
  F = "H
349 PRINT "LEXICON ADDITION IS:
  "L$(H1) + L$(HJ)
350 LC = LC + W: L$(LC) = L$(H1) +
  L$(HJ)
465 IF LEN (L$(LC)) = ML THEN:
  ML = LEN (L$(LC))
490 I = W
500 IW = I + W: IF S$(I) + S$(IW)
  = L$(LC) THEN: S$(I) = L$(LC)
  (I) = IW: FOR J = IW TO SC - W: S$(
  J) = S$(J + W): NEXT J: GOSUB
  900: SC = SC - W
510 PRINT S$(1): "
520 I = W: IF I = SC THEN: NEXT 500
530 IF I = SC THEN: PRINT S$(I)
534 TC = TC - HA: FOR I = SC + W TO
  TC: S$(I) = S$(I + HA): NEXT
  I
540 PLX(LC) = PLX(LC) + HA: L$(H1,
  HJ) = Z: PLX(H1) = PLX(H1) -
  PLX(LC): PLX(H1, Z) = PLX(H1, Z) -
  W: L$(Z, HJ) = L$(Z, HJ) - W
550 PRINT: PRINT "SC = "H1C
555 GOSUB 700: GOSUB 800
570 GOT0 326
700 REM: SORT ROUTINE
710 IF HJ (H1 THEN: H1 = HJ
715 FOR J = W TO LC - H1C = Z
720 FOR J = H1 TO LC - 1: JW = J +
  W
730 IF PLX(J) < PLX(JW) THEN: H =
  PLX(J): PLX(J) = PLX(JW): PLX(
  JW) = H: H1 = L$(J): L$(J) = L
  $(JW): L$(JW) = H1: FOR K = Z
  TO LC: H = L$(K, J): L$(K, J) =
  L$(K, JW): L$(K, JW) = H: NEXT
  K: FOR K = Z TO LC: H = L$(K, J)
  : L$(K, K) = L$(K, K): L$(K, J) =
  H: NEXT K: C = C + W
750 NEXT: IF C THEN: NEXT
750 IF PLX(LC) = ZERO THEN: L$(LC)
  = "": LC = LC - W: GOT0 76
  0
770 RETURN
800 REM: PRINT LEXICON ROUTINE.
810 PRINT "LEXICON = "L$(LC)
820 PRINT "I = "L$(1): "FREQUEN
  CY = "PLX(1)
830 FOR I = W TO LC
840 PRINT I, L$(I), PLX(I)
850 NEXT: RETURN
900 REM: READJUST L$(1, J) ROUTINE
  E.
910 C = TW: FOR K = W TO LC
920 IF S$(I - W) = L$(K) THEN: L
  $(K, LC) = L$(K, LC) + W: L$(K,
  H1) = L$(K, H1) - W: C = W
  : H = FN KP(L$(K, LC)): B = FN
  RM(L$(K, H1)): L$(K, Z) = L$(K,
  Z) + H: L$(Z, LC) = L$(Z, LC) +
  H: L$(Z, H1) = H
925 IF IW = SC THEN: NEXT: RETURN
930 IF S$(IW) = L$(K) THEN: L$(LC,
  C) = L$(LC, C) + W: L$(HJ, K) =
  L$(HJ, K) - W: C = W: H =
  FN KP(L$(LC, C)): B = FN RM(
  L$(HJ, K)): L$(LC, Z) = L$(LC, Z)
  + H: L$(Z, K) = L$(Z, K) + H:
  L$(HJ, Z) = L$(HJ, Z) + H: L$(Z,
  K) = L$(Z, K) + H
940 IF C THEN: NEXT
950 RETURN
2000 AS = "": PRINT "STRING I/P T
  O RECOGNISER = "
2030 FOR I = SC TO SC - ML + W STEP
  - W
2040 AS = S$(I) + AS: IF LEN (AS)
  < (ML - W) THEN: NEXT
2045 MS = I: NN = SC - MS + ML
2050 J = Z: PRINT
2060 FOR I = MS - W TO SC + ML -
  W
2062 FOR K = W TO LC
2065 IF S$(I) = L$(K) THEN: NEXT
  2068 B$(Z, J) = K: IF K = LC + W THEN
  : LC = LC + W: L$(LC) = S$(I)
  : "I": IF I = SC THEN: PL
  X(K) = PLX(K) - W: L$(K1, K) =
  L$(K1, K) - W: L$(K1, Z) = L$(K
  1, Z) + FN RM(L$(K1, K)): L$(Z,
  K) = L$(Z, K) + FN RM(L$(K1,
  K))
2080 IF I = SC THEN: AS = AS + L
  $(K)
2090 K1 = K: J = J + W: NEXT I
2100 PRINT: MI = J - W
2110 X$ = AS: J = W: W1 = LEN
  (X$): TK = W: FOR I = W TO TY
  : K$(I) = L$: NEXT
  2220 CO = Z: FOR I = W TO LC
  2235 IF L$(I) = L$(K) THEN: L$(I,
  CO) = L$(I, CO) + 1: NEXT: GOT0
  2270
2240 CO = CO + W: IF CO = W THEN
  : H$(Z, CO) = J: H$(J, CO) = 1: H$(K
  1, CO) = L$(K1, CO) - L$(K1, CO)
  : IF CO = W THEN: NEXT: GOT0
  2270
2245 TK = W: W1 = W: FOR I = W TO J -
  W: H$(O, TK) = H$(O, TK): NEXT:
  H$(J, TK) = 1: H$(TK, CO) = K$(K
  1) - L$(K1, CO) + L$(K, CO)
  : H$(J, CO) = H$(J, TK) = J
  2249 IF TK = K THEN: MK = TK
  2250 NEXT
  2270 IF TK = W THEN: GOSUB 2500
  2350 L1 = W: FOR K = W TO TK: IF
  K$(K) = Z AND K$(K) = L1
  : THEN: L1 = K$(K): KH = K
2370 NEXT: IF L1 AND K$(KH) THEN
  : K = K$(KH) = RIGHTS (AS, L1)
  : J = K$(Z, K) + W: GOT0 2220
2380 Y1 = TK: IF TK = W THEN: IOP =
  W: GOT0 2600
2400 HH = TT + TW: FOR J = W TO Y
  : K1E = Z1CH = Z: FOR J = W TO
  MI: E = E + PLX(H$(J, I)): NEXT
  I: E = E / MI: FOR J = W TO MI
  : CH = CH + ((PLX(H$(J, I)) -
  E) + TW) / E: NEXT: IF CH =
  HH THEN: IOP = I: H = CH
2440 NEXT: GOT0 2600
2500 REM: RECOGNISER SHRINK
  2502 FOR I = W TO TK: IF K$(I) =
  Z AND H$(Z, I) = MI THEN: MI =
  H$(Z, I)
2504 NEXT
2510 FOR J = W TO TK
  : IF H$(Z, I) = MI OR H$(Z, I) =
  MI AND K$(I) = Z: FOR J = W TO
  Z: TO: H$(Z, I) = H$(O, I) = H$(O,
  TK): NEXT: K$(I) = K$(TK)
  : TK = TK - W: I = I - W
2523 IF I = TK THEN: 2530
2525 NEXT
2530 FOR I = W TO TK: IF K$(I) THEN
  : RETURN
2540 NEXT: IOP = GOT0 2380
2540 REM: PRINT CHOSEN OPTION(S)
  AND THEN INTO 3000
2610 PRINT "RECOGNISER GIVES I = "
  : PRINT: FOR I = W TO H$(Z,
  O): PRINT L$(H$(I, O)): "I"
  : NEXT: PRINT
  : IF T1 = W THEN: PRINT "TIE
  -BREAKER: STOP
3000 REM: ROUTINE TO TAKE ON MOR
  E INPUT
3020 SC = SC - NN + ML - W + H$(Z,
  O)
3060 FOR I = W TO H$(Z, O)
3070 PLX(H$(I, O)) = PLX(H$(I, O))
  + W
3080 NEXT
3090 A = H$(Z, Z) + H$(W, O)
3120 L$(A, B) = L$(A, B) + W: L$(A, Z)
  = L$(A, Z) + FN KP(L$(A, B))
  : L$(Z, B) = L$(Z, B) + FN KP
  (L$(A, B))
3125 IF H$(Z, O) = W THEN: 316
  0
3130 FOR J = W TO H$(Z, O) - W
3132 A = H$(I, O): B = H$(I) + W: O)
3140 L$(A, B) = L$(A, B) + W: L$(A, Z)
  = L$(A, Z) + FN KP(L$(A, B))
  : L$(Z, B) = L$(Z, B) + FN KP
  (L$(A, B))
3150 NEXT
3160 DI = NN - H$(Z, O): TC = TC -
  DI: IF DI < Z THEN: FOR I = SC
  TO SC + W STEP - W: S$(I) =
  S$(I + DI): NEXT
3165 J = W
3170 FOR I = SC - H$(Z, O) + W TO
  SC
3180 S$(I) = L$(H$(J, O)): J = J +
  W
3190 NEXT
3200 IF DI < Z THEN: FOR I = SC
  + W TO TC: S$(I) = S$(I + DI)
  : NEXT
3220 RETURN

```


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74LS129	74LS129	30p	74LS325	100p		
74LS130	74LS130	30p	74LS326	100p		
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74LS132	74LS132	30p	74LS328	100p		
74LS133	74LS133	30p	74LS329	100p		
74LS134	74LS134	30p	74LS330	100p		
74LS135	74LS135	30p	74LS331	100p		
74LS136	74LS136	30p	74LS332	100p		
74LS137	74LS137	30p	74LS333	100p		
74LS138	74LS138	30p	74LS334	100p		
74LS139	74LS139	30p	74LS335	100p		
74LS140	74LS140	30p	74LS336	250p		
74LS141	74LS141	30p	74LS337	160p		
74LS142	74LS142	30p	74LS338	160p		
74LS143	74LS143	30p	74LS339	160p		
74LS144	74LS144	30p	74LS340	160p		
74LS145	74LS145	30p	74LS341	160p		
74LS146	74LS146	30p	74LS342	160p		
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74LS150	74LS150	30p	74LS346	160p		
74LS151	74LS151	30p	74LS347	160p		
74LS152	74LS152	30p	74LS348	160p		
74LS153	74LS153	30p	74LS349	160p		
74LS154	74LS154	30p	74LS350	160p		
74LS155	74LS155	30p	74LS351	160p		
74LS156	74LS156	30p	74LS352	160p		
74LS157	74LS157	30p	74LS353	160p		
74LS158	74LS158	30p	74LS354	160p		
74LS159	74LS159	30p	74LS355	160p		
74LS160	74LS160	30p	74LS356	160p		
74LS161	74LS161	30p	74LS357	160p		
74LS162	74LS162	30p	74LS358	160p		
74LS163	74LS163	30p	74LS359	160p		
74LS164	74LS164	30p	74LS360	160p		
74LS165	74LS165	30p	74LS361	160p		
74LS166	74LS166	30p	74LS362	160p		
74LS167	74LS167	30p	74LS363	160p		
74LS168	74LS168	30p	74LS364	160p		
74LS169	74LS169	30p	74LS365	160p		
74LS170	74LS170	30p	74LS366	160p		
74LS171	74LS171	30p	74LS367	160p		
74LS172	74LS172	30p	74LS368	160p		
74LS173	74LS173	30p	74LS369	160p		
74LS174	74LS174	30p	74LS370	160p		
74LS175	74LS175	30p	74LS371	160p		
74LS176	74LS176	30p	74LS372	160p		
74LS177	74LS177	30p	74LS373	160p		
74LS178	74LS178	30p	74LS374	160p		
74LS179	74LS179	30p	74LS375	160p		
74LS180	74LS180	30p	74LS376	160p		
74LS181	74LS181	30p	74LS377	160p		
74LS182	74LS182	30p	74LS378	160p		
74LS183	74LS183	30p	74LS379	160p		
74LS184	74LS184	30p	74LS380	160p		
74LS185	74LS185	30p	74LS381	160p		
74LS186	74LS186	30p	74LS382	160p		
74LS187	74LS187	30p	74LS383	160p		
74LS188	74LS188	30p	74LS384	160p		
74LS189	74LS189	30p	74LS385	160p		
74LS190	74LS190	30p	74LS386	160p		
74LS191	74LS191	30p	74LS387	160p		
74LS192	74LS192	30p	74LS388	160p		
74LS193	74LS193	30p	74LS389	160p		
74LS194	74LS194	30p	74LS390	160p		
74LS195	74LS195	30p	74LS391	160p		
74LS196	74LS196	30p	74LS392	160p		
74LS197	74LS197	30p	74LS393	160p		
74LS198	74LS198	30p	74LS394	160p		
74LS199	74LS199	30p	74LS395	160p		

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15V 7815 50p 7915 60p	LM337T 225p 79GUIC 225p
18V 7818 50p 7918 60p	LM323K 500p 79HGKC 700p
24V 7824 50p 7924 60p	LM723 37p ICL 7660 200p
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5502H				6400MHz
5502I				12800MHz
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5502BS				59029581039065765171200MHz
5502BT				118059162078131530342400MHz
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5502CC				60446289064000333423308800MHz
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5502CE				241785156256000133693235200MHz
5502CF				483570312512000267386470400MHz
5502CG				967140625024000534772940800MHz
5502CH				193428125004800010

Filling gaps in a sentence is more than just a game. Using Chris Harrison's Cloze program it can provide a scientific test of language ability.

Watch this space

THE CLOZE testing procedure is a reliable and well-validated system of language testing. The candidate is required to complete a language item such as a paragraph of text by filling in blanks that appear at regular intervals.

This Cloze program gives the tester an instrument which enables a passage of virtually unlimited length to be written to the screen. Words are then deleted at regular intervals and the student fills in the gaps.

Easily portable

The program is fairly simple, and could be easily modified to draw on prepared and stored texts. It is written for a standard Video Genie, but can be made machine-portable without difficulty. The principal variables are:

A\$ holds individual words of the text, each one defined by the spaces between them. The program shows a Clear of 1000 and a dimension of A\$(100), but both can be increased to the limit if you want a text longer than 100 words.

R\$ holds the student's response, which does not need to be dimensioned.

M is used to count and number the words in the text.

N counts the letters in each word, in case back-spacing is required for corrections. Since each word is defined as soon as a space is added it is not possible to back-space over blanks. If you are not likely to want to make alterations it is better to use Data statements instead, or a routine that calls text from store and then counts words by using the blanks between them. If this is to remain simple, though, the text will be limited to 256 characters.

Text is entered using Inkey\$, and printed to screen. If you are a fast typist, using a lower-case modification, you may find this rather slow but it is satisfactory for most purposes. The Rems in the listing show exactly what is happening and can be omitted from the program.

Sample run of Cloze program.

```
I ONCE ---- BACK FROM - SKIING TRIP ----- TO FIND ---- A SNOWSTORM --- FALLEN
AT --- AIRPORT AND ---- THE DOOR ----- ON ALL --- CARS IN --- CAR PARK ---- SO F
ROZEN -- THAT IT --- IMPOSSIBLE TO ----- A KEY.
```

COME

NO, BAD LUCK. TRY AGAIN.
CAME

I ONCE CAME

A

I ONCE CAME BACK FROM A

ABROAD

I ONCE CAME BACK FROM A SKIING TRIP ABROAD

THAT

I ONCE CAME BACK FROM A SKIING TRIP ABROAD TO FIND THAT

WAS

NO, BAD LUCK. TRY AGAIN.
HAVE

NO, BAD LUCK. TRY AGAIN.
HAD

I ONCE CAME BACK FROM A SKIING TRIP ABROAD TO FIND THAT A SNOWS

TORM HAD

THE

I ONCE CAME BACK FROM A SKIING TRIP ABROAD TO FIND THAT A SNOWS

TORM HAD FALLEN AT THE

DOOR

NO, BAD LUCK. TRY AGAIN.
LOCKS

NO, BAD LUCK. TRY AGAIN.
THAT

I ONCE CAME BACK FROM A SKIING TRIP ABROAD TO FIND THAT A SNOWS

TORM HAD FALLEN AT THE AIRPORT AND THAT

LOCKS

I ONCE CAME BACK FROM A SKIING TRIP ABROAD TO FIND THAT A SNOWS

TORM HAD FALLEN AT THE AIRPORT AND THAT THE DOOR LOCKS

ETC ETC

The inputter is asked what interval is required between spaces. The screen is then cleared and the Clozed text is then printed out, with a message asking the

student to supply a word for the first available blank. Certain areas of the screen are used for messages and replies
(continued on next page)

Cloze program listing.

```
10 CLS
20 PRINT@410,"C L O Z E";
30 PRINT@597,"BY CHRIS HARRISON      1982";
40 FOR I=1 TO 1000:NEXT
49   REM A$=words of text; R$=students response to
    first available blank.
50 CLEAR 1000:DIMA$(200),R$(200)
59   REM asterisk required by Program to show the
    end of the Program
```

(listing continued on next page)

(continued from previous page)

— see lines 300, 330, 350, 360, 380 — and these locations are all up against the left-hand side of the Video Genie screen, 0 to 960, Step 64.

The student is given three tries, and if unsuccessful is given the correct answer. It should be quite simple to write a routine that allows students to move the cursor to the beginning of a space that they think they can fill, but this refinement is far from essential.

Reliable test

If you are planning to use the technique, it is advisable to make sure that you understand the research and evaluation on which it is based.

There is little doubt that the regular blanking out of words, say one word in six, gives a very much more reliable measure of language competence than blanking out, say, all prepositions. Alderson reports that deleting every 12th word did not necessarily result in an easier test than deleting every sixth, eighth or 10th word, and that Cloze items are, on the whole, unaffected by content greater than five words. Anderson shows that the Cloze techniques correlate with difficulty levels and discriminate well between students.

Learning effects

Bialystock shows that it is possible to improve students' inferencing abilities through classroom training. Briere finds that it is possible to discriminate between students of foreign languages according to their level of instruction — first, second or third term — even when the languages involved are different. Darnell reports on ways of scoring Cloze tests, and Oller indicates that Cloze tests are internally consistent, reliable, valid and easily constructed, administered and standardised, and that Cloze tests measure a grammar of expectancy. 

Key articles

- Alderson, J Charles, "The effect on the Cloze test of changes in deletion frequency", *Journal of Research in Reading* (Leeds), 2 (1979), 108-119.
- Anderson, Jonathan, "The application of Cloze procedure to English learned as a foreign language in Papua and New Guinea", *English Language Teaching* (London), 27 (1972), 66-72.
- Bialystock, Ellen, "Inferencing as an aspect of Cloze test performance", *Working Papers on Bilingualism* (Toronto), 17 (1979) 24-36.
- Briere, Eugène J, "A look at Cloze testing across languages and levels", *Modern Language Journal* (St. Louis, Mo) 62, (1978), 23-26.
- Darnell, Donald K, "Clozentropy: a procedure for testing English language proficiency of foreign students", *Speech Monographs* (New York), 37 (1970), 36-46.

(listing continued from previous page)

```
60 CLS:PRINT@2,"WRITE YOUR TEXT IN HERE WITHOUT USING COMMAS.
    WHEN YOU HAVE FINISHED MAKE A SPACE AND FOLLOW
    IT WITH AN ASTERISK THUS 'END.*'"
69 REM Now we turn on the cursor for INKEY input
70 PRINT:PRINTCHR$(14);
79 REM it's necessary to count and number each
    word
80 M=M+1
89 REM N will set letters in the word counter
90 N=1
99 REM text is now input one letter at a time
100 I$=INKEY$
109 REM a delicate Process thus line 110
110 ON ERROR GOTO 90
120 REM now we allow for erasure. If N<1 then we
    start the word again. If backSpace is used,
    then we must reverse the cursor and ignore the
    previous letter. No backspacing over blanks!
130 IF N<1 THEN GOTO 90ELSE IF I$=CHR$(8)
    THEN A$(M)=LEFT$(A$(M),N-2):N=N-1:ON ERROR
    GOTO 90:PRINT CHR$(8):GOTO100
140 IF I$=""THEN100
149 REM we must ensure that a space isn't counted
    as a word, but we use it to mark off each word
150 N=N+1:IF I$=" " THEN PRINT":GOTO80
159 REM if input = '*' text is finished and Program
    moves on to next stage.
160 IF I$="*"THEN210
169 REM if return key is Pressed no action is taken
170 IF I$=CHR$(13)THEN 100
179 REM Each word is built up from individual letters
180 A$(M)=A$(M)+I$
189 REM now we Print out each letter
190 PRINTI$;
199 REM repeats the Process
200 GOTO 100
209 REM S is used for intervals of spacing.....
210 PRINT:PRINT:INPUT " WHAT INTERVAL DO YOU WANT";S
219 REM....but an entry of '3' means 2 words then
    a blank
220 S=S-1
230 REM OK. now we are ready. Clear screen and.....
240 CLS
249 REM turn off cursor
250 PRINTCHR$(15);
269 REM now we Print a space before each word, and
    print the words except for those every S-1 when
    we print as many dashes as there are letters
270 PRINT":FOR I=1 TO MSTEP S:FOR J=I TO I+S-1:
    PRINTA$(J);":NEXT J:
    PRINTSTRING$(LEN(A$(J)),45);":I=I+1:NEXTI
279 REM Now allow for as many answers as there
    are blanks.
280 FOR I=S+1 TO M STEP S+1
299 REM now blank out the Part of the screen (897)
    we will use for messages and allow for answers
300 PRINT@897,STRING$(64,32);
    PRINT@897,"NOW FILL IN THE BLANKS":INPUT R$(I)
309 REM is the answer correct?
310 IF R$(I)=A$(I)THEN 350
325 IF V>1 THEN PRINT@770,"BAD LUCK. THE
    WORD IS ":A$(I):ELSE 330
326 FOR L=1 TO 300:NEXTL:GOTO 350
329 REM if reply was wrong we give another try
330 PRINT@770,"NO, BAD LUCK. TRY AGAIN.":V=V+1:GOTO300
349 REM if the reply was correct we reprint the
    original text up to the Point we have reached
350 PRINT@0,"":FOR K=1 TO I:PRINTA$(K);":NEXT K
359 REM and blank out the 'no' message
360 PRINT@770,STRING$(64,32);
369 REM repeat if more blanks remain
370 V=0:NEXT I
379 REM blank out the request to fill in blanks
380 PRINT@897,STRING$(64,32);
389 REM allow for a re-run
390 PRINT@897,"DO YOU WANT ANOTHER (Y/N)":INPUT R$
400 IF R$="Y" ELSE IF R$="n" THEN 50
410 CLS:PRINT@400,"F I N I S H"
420 GOTO 420
```


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TRAIN—multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS—fractions explained at three levels of difficulty. A ten-question test completes the program.

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For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

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COMBAT—you're on a suicide space mission. You have only 12

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SUBSTRIKE—on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER—the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY—in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

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For ZX81 (and ZX80 with 8K BASIC ROM)

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VOLUMES—'yes' or 'no' answers from the computer to a series of cube volume calculations.

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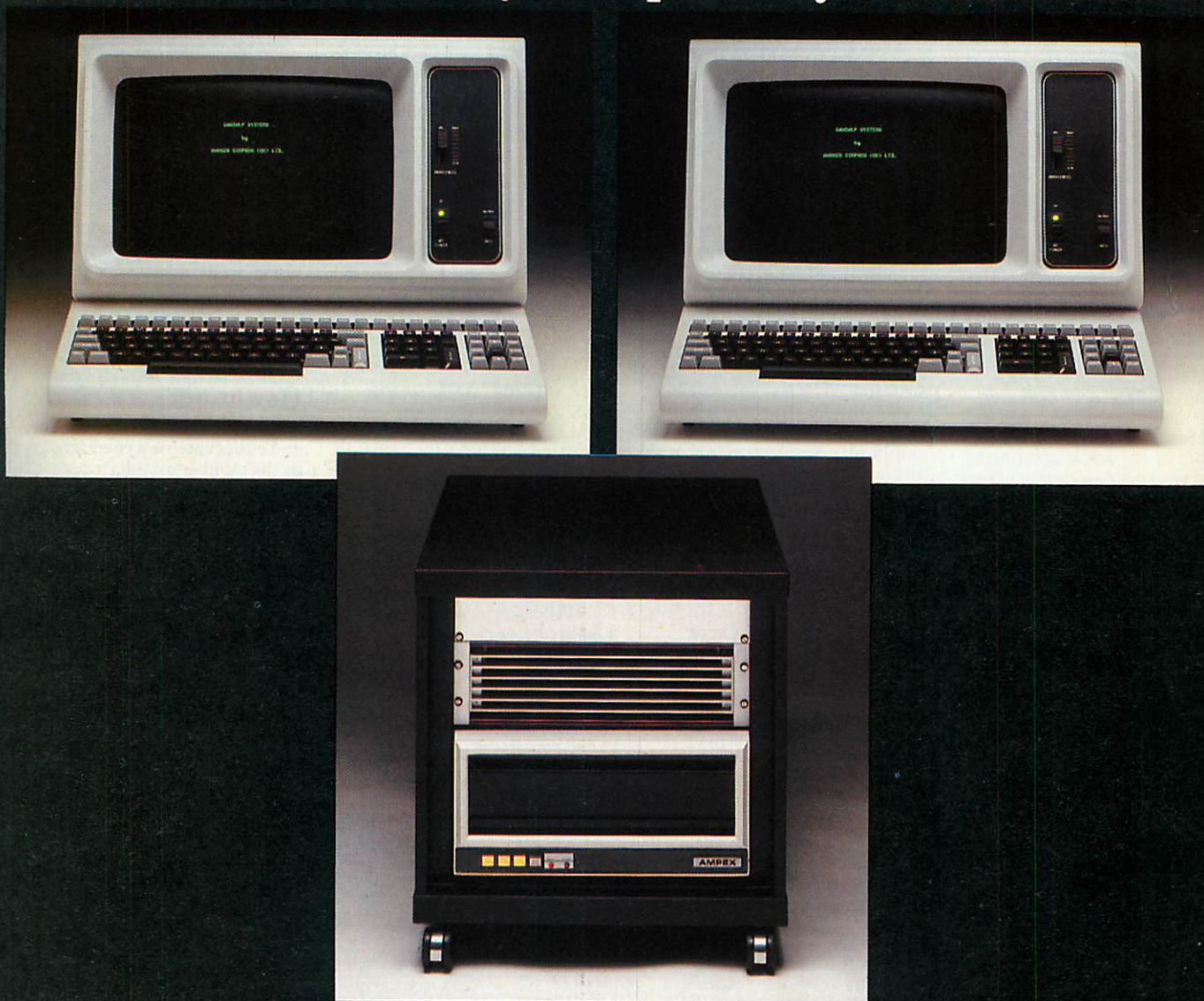
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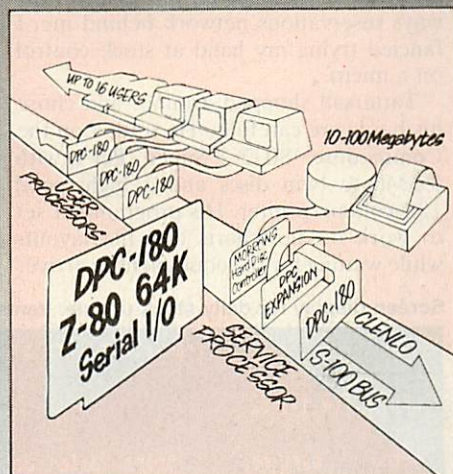
From as little as £6580.00 (plus VAT) you can enter the world of multi-user distributed processing with the CLENLO ACE MULTI-USER SYSTEM.

The only genuine Micro multi-processor system readily available with the full range of multi-user facilities.

With the CLENLO ACE multi-user system up to sixteen users each have exclusive use of a Z-80A processor and 64K RAM mounted on a S-100 board, each with a serial RS-232 I/O port to which the user's VDU is attached.

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Microcomputers
designed for business

The CLENLO ACE multi-user system supports full multi-user facilities:

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For more details of the best, lowest cost multi-user system on the market and our complete range of Microcomputer and business services contact CLENLO COMPUTING SYSTEMS, Telephone 01-670 4202/3.

To: CLENLO COMPUTING SYSTEMS LIMITED,
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Telephone: 01-670 4202/3.

- ☐ Please send me details of your ACE MULTI-USER SYSTEM.
- ☐ Please send me details of the complete CLENLO range.

Name _____

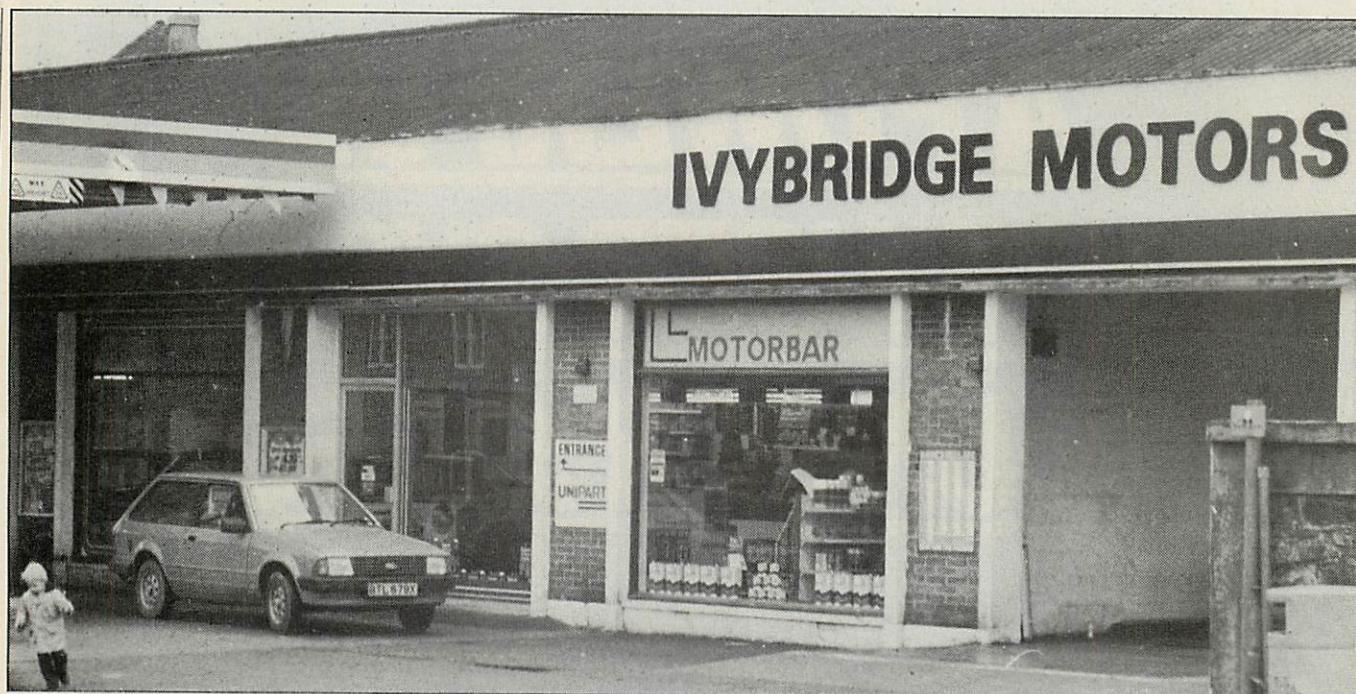
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DAVE TATTERSALL runs a thriving garage business in the South Hams town of Ivybridge, on the edge of Dartmoor. As well as selling petrol and offering car repairs and servicing, Ivybridge Motors is a BL retail outlet dealing in BL cars and components. The stores hold over 3,000 lines in BL and Unipart spares, and a wide range of items such as cigarettes, sweets and car accessories are sold in the shop.

Stock information

Keeping track of such a large and diverse selection of stock is no mean feat — how many of each line you have, where the items are, what it is all worth, and which lines are worth continuing. A comprehensive up-to-the-minute stock information service is the key to profitability in this line of business.

Over the past 18 months, Dave Tattersall had been approached by a number of people touting computerised stock-control systems at prices ranging from £250 to £25,000. The cheapest system offering simply quantity-in-stock for sequentially-numbered stock items, was written off as "Probably great for a toothbrush salesman stocking 50 different lines, useless to us". The most expensive, jointly marketed by ICL and BL, was clearly designed for big main dealers, and was far too high-powered for the pocket or the needs of the High Street retail dealer. Nobody was offering the level of sophistication needed, at a price that was realistic. Convinced that micro-computers held the key to stock management for the High Street retailer, Tattersall concluded that it was up to him to define a system to suit his needs.

I first met Dave Tattersall, and his parts manager Chris Hatch, when they signed up for a short introductory course on computing which I was running at Ivybridge Community College. We

talked over the application he had in mind, and the sort of hardware he was likely to need. I was a little disappointed to hear that they already had someone lined up to write the software, a professional programmer working for a major corporation locally. With substantial real-time experience on the British Airways reservations network behind me, I fancied trying my hand at stock control on a micro.

Tattersall shopped around, and chose his hardware carefully. He settled on the Commodore 8032 "Super Pet" with 0.5Mbyte twin discs and a high-speed 132-column printer. His programmer set to work on flowcharts and file layouts while waiting for the equipment to arrive.

About this time, things started to go awry. There was a hold-up, as ever, in the delivery of this system. By the time it arrived, his programmer had already been told that his firm was pulling out of Devon and he was due to move to the States in a matter of weeks. On his departure, Ivybridge Motors became the proud possessor of an unproved and very unwieldy prototype system, a poor match for the £3,000-worth of hardware supporting it.

Software misgivings

I was a little surprised to hear from Dave Tattersall again, and listened with some misgivings to his suggestion that I take on software maintenance of his new

Screen display for daily stock update. Items 6 to 10 are used only for new entries.

IVYBRIDGE MOTORS STOCK UPDATE. INPUT

UPDATE FOR 1/1/82

entry	part no.	trans. date	doc. no.	i/r	quantity	new
4	gbf101	1/1/82	0958	i	1	
5	ztb001	1/1/82	0958	i	1	
6	ztb024	1/1/82	0958	i	1	
7	za024	1/1/82	0958	i	1	

1. part no.(or end) GAE201

2. date 1/1/82

3. doc. no.(or del) 0958

4. issue/rec. 1

5. quantity 1

6. retail price

7. dis. code

8. bin loc.

9. supplier data

0. description

any changes?

Keeping track of spare parts — they managed it on a micro

Grahame Blackwell took part in a bid to automate a High Street garage's stock list.

programs. After seeing the system in action, I tactfully suggested that instead I work with Chris Hatch on developing a comprehensive stock control system from scratch. A feasibility study soon established that Tattersall's chosen equipment was capable of supporting a real-time system with response times of three to four seconds on an inventory of over 5,000 line items.

The months that followed were very interesting and highly educative for both sides, though not always easy. Few computer users appreciate how long and involved is the path from testing an idea to making it foolproof and fully operational, and Ivybridge Motors was no exception. Getting the best out of the computer in terms of speed, storage and user interaction involved copious reference to *The Pet Revealed* and a few phone calls to Commodore.

Chris Hatch has picked up a good deal of knowledge about computer programs, and has on a number of occasions sat at the keyboard and modified a program as I phoned the amendments to him. For my part I learned a great deal about the garage business, and how to relate a computerised information system to that business.

User friendly

I also learned how closely Chris Hatch had followed my evening classes; he regularly quoted back at me my bland statement that "It is not up to users to adapt to the computer — it should be the other way round", whenever he felt that a little more programming could make his job easier. This guiding principle has led us to a system that is quick and simple for the non-specialist to use, and which meets all the main record-keeping requirements of Chris Hatch and others in his line of business.

The initial specification was for a system to hold detailed stock information on up to 5,000 line items, and permit access to that information and amendment of it. The system was also to have included a facility to update stock information on a daily basis, reflecting the day's transactions, and to provide a printout of those

transactions suitable for audit trail. The information to be held for each item included:

part number
description
retail price
cost price
discount code
minimum stock level
quantity in stock
supplier details
on-order indicator
sales category, to indicate throughput

Over the months, various features have been added as the need for them became apparent, such as special handling of sale-or-return stock "Customers' Bench" one-off orders giving a finished system several stages removed from the first draft.

Justifiably proud

Chris Hatch is more than pleased with the facilities the system now offers him, and is justifiably proud of his part in defining it. In just 10 minutes at the end of the day he can feed in all the information on the day's transactions, including items sold, orders delivered and stock ordered.

At any time he may access comprehensive information on any stock item, and can modify that information if necessary after input of a security code. He may also obtain a full printout of stock information, or of a selection of stock items under one of a number of different categories, including a cost and retail stock evaluation for each line item and for total stock. These printouts are in part-number order corresponding to BL catalogues and price lists, rather than a simple alphanumeric ordering.

After each day's stock update, he is provided with a transaction list, a printout of the new state of stock affected and a reorder list. Special facilities ease the twin burdens of stocktaking and re-pricing. The system monitors monthly throughput of each line item, and a variable indicator gives a constant check on profitability for each.

The package has received the seal of approval from the accountants who act for Ivybridge Motors and they intend to recommend it to other clients. Satisfied

that his first step into the computer world has been amply justified, Dave Tattersall has recently purchased a business accounts package to run on his Commodore system. For a total outlay of under £5,000, he now has a comprehensive management information system which should increase efficiency and profitability and reduce expenditure on other management aids, such as bin price list for stock. He expects the system to have paid for itself in a relatively short period and is now looking to this computer to streamline other facets of his business, such as customer follow-up.

Vested interests

It is perhaps as well the system was up and running before Dave Tattersall received a BL circular detailing the findings of a consultative committee. It stated, in effect, that it would not be possible to maintain stock information for such a business on a microcomputer. One wonders how such findings are



Chris Hatch explains the system's finer points to manager Dave Tattersall.

arrived at, and whether micros are being judged according to criteria handed down from mainframe experience.

Ivybridge Motors' short-lived initial package bears this out. Its file structures and program layouts were a model of good commercial programming practice, and worked well on test data of 200 items. Yet the full database of over 3,000 items led to an unacceptable four-minute response time, and the system ran out of disc space. Its extravagant file layout, with repetitive record headers and superfluous field delimiter characters, and programs making use of sequential disc searches over large numbers of records were totally inappropriate to the micro environment. The programmer himself was the first to agree that a rethink was needed.

The microcomputer is now the best solution to many medium and large-scale problems in information handling. It would be a shame if vested interest or inflexible outlook were to pronounce it unfit for service. By the same token, those from a mainframe or minicomputer background who are prepared to adapt to the micro's particular operational constraints will be able to bring a much-needed wealth of experience to bear on this fast-growing infant. □

Did you pay too much tax last year? Elizabeth Acraman shows how button. The program can also be modified to assess your 1982/83 liability

Keeping income tax in

ONE OF THE LEAST popular ways in which the Government raises money is by income tax. It is levied on your total income, with some minor exceptions, less the allowances to which you are entitled during the tax year — the 12-month period ending on April 5 each year. This program will enable you to check your income tax liability according to the present Finance Act. It is written for a 40-column Pet with a CBM 3022 printer.

After establishing your name, the computer asks for your status — male or female; single, married or widowed. If you are a married woman it asks if you wish to calculate income tax just for yourself, in which case you will be

regarded as a single woman, or jointly with your husband, when you will be regarded as a married man.

If you are a widow, the Pet asks if your husband died before April 6, 1981 in order to establish your entitlement to the Special Bereavement Allowance for the year in which your husband died. If applicable, it is calculated by reference to the date of his death.

You are then asked to enter details of your income and outgoings for the year:

Earnings — that is salary or wages — including overtime, commission, etc.

Benefits in kind, such as company car, cheap loans, etc. Note that some benefits are not taxable and some are only taxable if you

count as "higher paid". Your employer should be able to advise you of the amount of benefit on which you are liable to tax.

Allowable expenses, which are defined as those necessary for your work, such as tools, professional subscriptions etc.

Pension contributions to your employer's pension fund. This does not include your National Insurance deductions.

State pensions receivable which are taxable, such as retirement pension — excluding supplementary, widow's pension, etc.

Other pensions receivable, for example, from former employer or personal pension if you were given tax relief on the payments you made into the scheme.

Gross amount of any income you receive under a deed of covenant, and the tax deducted from it.

1981/82 tax liability check

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710 PRINT "INCOME TAX :-"
720 PRINT "MARRIED" : JUST FOR YOURSELF
730 PRINT "MARRIED" : JOINTLY WITH YOUR HUSBAND
740 PRINT "MARRIED" : JOINTLY WITH YOUR HUSBAND
750 INPUT SC : IF SC<10 OR SC>2 THEN 760
760 INPUT SC : IF SC<10 OR SC>2 THEN 760
770 SE=1
780 RETURN
790 REM ***MARRIED MAN***
800 PRINT "MARRIED PLEASE ENTER THE SAME
810 PRINT "DETAILS IN RESPECT OF YOUR WIFE
820 C=3
830 GOTO 860
840 PRINT "PLEASE ENTER YOUR INCOME
850 PRINT "AND OUTGOINGS FOR THE YEAR
860 FOR=1010
870 PRINT "ENTER "1" (R)
880 INPUT R : R(R,C)=INT(R)/NEXT
890 GOSUB 1720
900 R(C,C)=R(R,C)-R(4,C)
910 R(C,C)=R(C,C)+R(8,C)
920 R(C,C)=R(C,C)+R(10,C)
930 R(C,C)=R(C,C)+R(13,C)
940 R(C,C)=R(C,C)-70
950 IF R(11,C)<0 THEN R(11,C)=0
960 R(11,C)=R(11,C)+R(15,C)
970 R(15,C)=R(15,C)-R(16,C)
980 GOSUB 1890
990 IF SE=1 AND R(15,C)=2 THEN 790
1000 FOR=21010
1010 R(0,1)=R(0,2)+R(0,3)
1020 R(0,2)=0
1030 R(0,3)=0
1040 NEXT
1050 FOR=11017
1060 I=1+R(R,1)
1070 S=S+R(R,2)
1080 M=M+R(R,3)
1090 NEXT
1100 T=I+S+M
1110 O=0
1120 PRINT "MARRIED YOU CLAIM DEPENDENT
1130 PRINT "RELATIVE ALLOWANCE?"
1140 GOSUB 260
1150 IF=1 THEN 1170
1160 GOTO 1200
1170 INPUT "FOR HOW MANY RELATIVES?" : I
1180 IF SE=2 AND I=1 OR (SE=2 AND I=3) THEN 1200
1190 B(4)=100+0
1200 IF SC<3 THEN 1240
1210 PRINT "MARRIED YOU CLAIM HOUSEKEEPER ALLOWANCE?"
1220 GOSUB 260
1230 IF=1 THEN B(5)=100
1240 PRINT "MARRIED YOU CLAIM ADDITIONAL
1250 PRINT "PERSONAL ALLOWANCE"
1260 GOSUB 260
1270 IF=1 THEN B(6)=770
1280 PRINT "MARRIED YOU CLAIM ALLOWANCE?"
1290 PRINT "MARRIED OR SON/DAUGHTER SERVICES?"
1300 GOSUB 260
1310 IF=1 THEN B(7)=55
1320 PRINT "MARRIED YOU CLAIM
1330 PRINT "BLIND PERSONS ALLOWANCE?"
1340 GOTO 860
700 PRINT "MARRIED YOU WISH TO CALCULATE
690 GOTO 860
680 PRINT "EXISTENCE YOU WERE WIDOWED"
670 PRINT "PLEASE ENTER YOUR INCOME AND OUTGOINGS"
660 B(1)=1375
650 B(3)=INT(M/12*770)
640 REM ***CALCULATE WIDOWS ALLOWANCE***
630 GOSUB 340
620 PRINT "PLEASE ENTER DATE OF DEATH IN NUMBERS"
610 IF=1 THEN B(4)=0
600 GOSUB 260
590 PRINT "MARRIED BEFORE 6 APRIL 1981?"
580 PRINT "MARRIED YOUR HUSBAND DIED
570 GOTO 840
560 IF SE=2 AND R(5)=3 THEN 580
550 IF SE=2 AND R(5)=2 THEN 580
540 INPUT SS : IF SC<10 OR SS>3 THEN 490
530 PRINT "PLEASE INDICATE 1, 2 OR 3
520 PRINT "MARRIED
510 PRINT "MARRIED
500 PRINT "SINGLE OR DIVORCED
490 PRINT "MARRIED YOU :-"
480 INPUT SE : IF SE<10 OR SE>2 THEN 450
470 PRINT "PLEASE INDICATE 1 OR 2
460 PRINT "MARRIED" : MALE "M" (1) "2" FEMALE
450 PRINT "MARRIED YOU :-"
440 C=2
430 INPUT N
420 PRINT "MARRIED WHAT IS YOUR NAME?"
410 RETURN
400 IF V=1981 THEN M=M-12
390 IF C<1 THEN M=M-12
380 IF C<1 THEN M=M-12
370 IF C<1 THEN M=M-12
360 INPUT "YEAR" : Y : IF Y<1900 THEN Y=Y+1900
350 INPUT "MONTH" : M
340 INPUT "DAY" : D
330 GOTO 270
320 NEXT
310 IF M(1)=2 THEN 310
300 FOR=21010
290 GET R : IF R=1 THEN 290
280 Z="M"
270 PRINT "PLEASE INDICATE 'Y' OR 'N'"
260 REM ***INPUT SUBROUTINE***
250 GOTO 420
240 FOR=1104 : REPEAT (R) : NEXT
230 FOR=1107 : REPEAT (R) : NEXT
220 FOR=1108 : REPEAT (R) : NEXT
210 FOR=11017 : REPEAT (R) : NEXT
200 F2=" "
190 F1=" "
180 F=" "
170 Y=CHR$(29)
160 FOR=1103 : OPEN N, 4, X-1 : NEXT
150 DEFN(X)=LEN(STR$(X))
140 DIM B(12,3) : I=1 : C=1 : R(8,C)=INT(S)
130 CLR
120 REM ***COPYRIGHT FEB 1982***
110 REM ***G. ACRAMAN***
100 REM ***INCOME TAX***

```


nd out at the touch of a

check

Gross amount of dividends received, and the tax deducted from them

Total amount of interest received from a National Savings Bank ordinary account last year. In the first and last years of receipt of such interest the amount should be the current year's interest. The first £70 of such interest is tax free, and this will be automatically allowed for in calculating your income tax.

Any other investment income, such as bank interest, local authority loan, etc., and the tax deducted from this.

Interest received from building society accounts. Building society interest is received "tax paid" but for some purposes it must be grossed up for the notional basic rate of tax. This is calculated by the program and the notional tax is treated as tax already deducted.

Mortgage interest allowable, and then any other interest allowable on qualifying loans.

The Pet then asks if you wish to check your entries. If so, each item and the amount you entered will be displayed in turn. You may agree or amend any item. You are then asked if any of your duties were performed abroad; if you worked abroad for the whole year, your earnings will not be subject to income tax. If you worked abroad for more than 30 days in the year, a quarter of your earnings for that period are free of tax, and this will be automatically calculated and allowed.

If you are a married man you are then asked to enter all the information on income, pensions, interest, etc., in respect of your wife. If you were married during the year only your wife's income after your marriage should be entered.

The next stage is to enter your entitlement to various allowances, such as for dependent relative, housekeeper — only available to a widower or widow — additional personal allowance for those bringing up children on their own, son's, daughter's services, and blind person's allowance. You are then asked if you — or your wife if you are a married man — were born before April 6, 1917, to establish your entitlement to Age Relief. This is a higher rate of personal allowance, but is subject to abatement if your taxable income is above a specified level. All the relevant calculations are built into the program.

If you are a married man the program asks if you were married before April 6, 1981. If not, your married man's personal allowance is adjusted to take account of the date of your marriage and, again, this calculation is built into the program. For the year of your marriage your wife is treated as a single woman — with the full

	Present Value (1981/2) £	Variable	Line number(s)
Allowances			
Personal allowance			
single	1375	B(1)	660, 1420, 1470
married man	2145	B(1)	1540, 1670
Age relief (maximum)			
single	1820	B(1)	1450
married	2895	B(1)	1650
trigger for abatement	5900		1460, 1660
Additional personal allowance			
in year of marriage	770		1620
Widows bereavement allowance			
(whole year)	770	B(3)	650
Wife's earned-income relief			
(maximum)	1375	B(2)	1690, 1700
Dependent relative			
for single woman	145	B(4)	1180
other	100	B(4)	1190
Housekeeper	100	B(5)	1230
Additional personal allowance	770	B(6)	1270
Son or daughter services	55	B(7)	1310
Blind person	180	B(8)	1350
Tax			
Tax rate bands			
first	11250		2060, 2100, 3820
next	2000		2090, 3820
next	3500		2110, 3820
next	5500		2130, 3830
next	5500		2150, 3830
Rates of tax			
first	30%		2060, 2080
second	40%		2090, 2100
third	45%		2110, 2120
fourth	50%		2130, 2140
fifth	55%		2150, 2160
top	60%		2170
Investment income surcharge			
trigger	5500		2190, 2200
rate	15%		2200
Notional tax on building			
society interest	30/70	Q	960
Overseas earnings			
minimum number of days eligible			
for relief	30	N	1980
proportion of earnings relieved	25%		1990
Tax-free interest on ordinary			
savings accounts	£70		940
Dates			
date of birth for eligibility to			
age relief	6.4.1917		1390, 1510
beginning of tax year	6.4.1981		590, 1560, 370, 400
current tax year	1981/82		3010

Variables for checking 1981/82 tax.

single person's personal allowance — for the first part of the tax year up to the date of your marriage. For the second part of the tax year, after the date of your marriage, she is entitled to the wife's earned income relief on her earnings during that period.

Your personal allowances, wife's earned-income relief, if applicable, together with income tax payable at the various rates and investment income surcharge are all calculated by the program. If you are entitled to any repayment of tax, this is also calculated and shown.

You then have the option of having the

calculations displayed on the screen in three sections — Income, Allowances and Tax Payable — or printed out. The program is designed to cater for straight-forward income tax assessments, which covers the majority of cases. If there are individual circumstances which affect your particular case you will need to adjust the calculations to take account of them.

Cassettes of this program for both the 1981/82 and 1982/83 tax years are available from the author at 49 Kingsend, Ruislip, Middlesex for £4, including postage and packaging. 

EQUINOX

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CBASIC: Compiler Systems, Inc.

MBASIC: Microsoft

CPM: Digital Research

WORDSTAR: MAILMERGE: MicroPro International

REGISTERED TRADEMARKS:

MBASIC & CBASIC for programming.

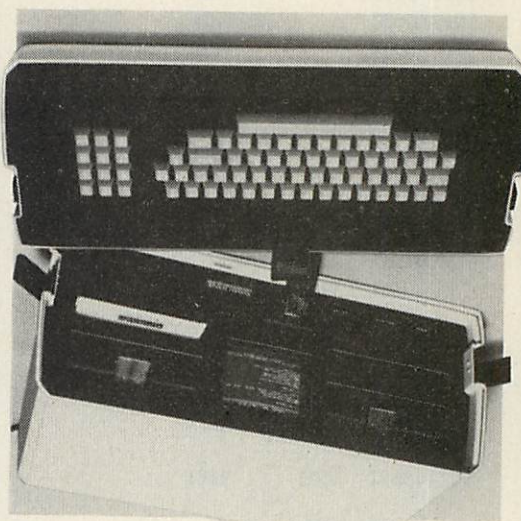
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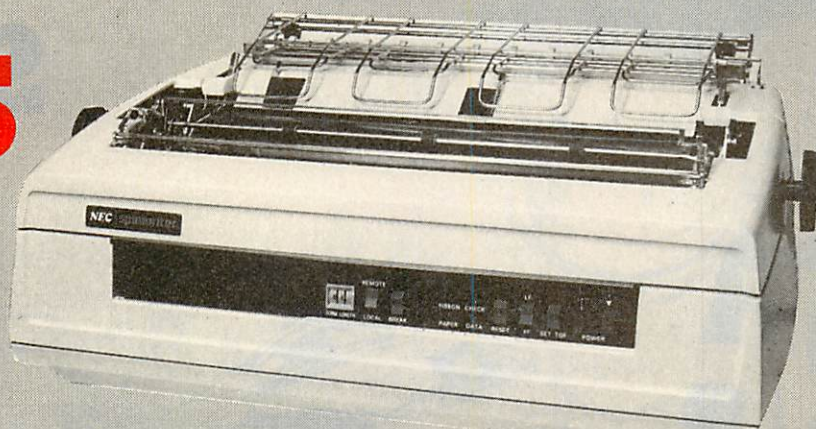
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1340 GOSUB260
1350 IFZ=1 THENB(9)=180
1360 REM**PERSONAL ALL-MARRIED COUPLE**
1370 IFEE=1 ANDSS=2 THEN1430
1380 REM**PERSONAL ALL-SINGLE**
1390 PRINT"WHERE YOU BORN BEFORE 6 APRIL 1917?"
1400 GOSUB260
1410 IFZ=1 THEN1440
1420 B(1)=1375
1430 REM**SINGLE-AGE RELIEF**
1440 IFZ=1 THENB(1)=INT(B(1)-(T-5900)*2/3)
1450 B(1)=1820
1460 IFZ=1 THENB(1)=INT(B(1)-(T-5900)*2/3)
1470 IFB(1)<1375 THENB(1)=1375
1480 REM**MARRIED COUPLE**
1490 PRINT"WOULD YOU LIKE TO CHECK
1730 PRINT"YOUR ENTRIES?"
1740 GOSUB260
1750 IFZ=1 THEN1770
1760 RETURN
1770 FOR=1 TO16
1780 PRINT"PRINTING(R),R(R,C)
1790 PRINT"THIS ONE ALRIGHT?"
1800 GOSUB260
1810 IFZ=1 THENNEXT
1820 RETURN
1830 RETURN
1840 INPUT"PLEASE INPUT REVISED AMOUNT:R(R,C)=INT(G)
1850 PRINT"DO YOU WISH TO CONTINUE?"
1860 GOSUB260
1870 IFZ=1 THENNEXT
1880 RETURN
1890 REM**OVERSEAS EARNINGS**
1900 PRINT"WHERE MAY BE YOUR DUTIES
1910 PRINT"PERFORMED ABROAD?"
1920 GOSUB260
1930 IFZ=1 THEN1950
1940 RETURN
1950 PRINT"HOW MANY DAYS WERE SPENT ABROAD?"
1960 INPUTN
1970 IFND=364 THENB(17,C)=(R(1,C)+N*(2,C))*-1:RETURN
1980 IFN<30 THENRETURN
1990 R(17,C)=INT(N/365)
2000 RETURN
2010 REM**CALCULATE TAX**
2020 FOR=1 TO8
2030 B=B+B(R)
2040 NEXT
2050 C=T-B
2060 IFZ=1 THENB(1)=11250*.3:GOTO2090
2070 IFZ=1 THENB(1)=0:GOTO2180
2080 C(1)=C*.3:GOTO2180
2090 IFZ=1 THENB(2)=2000*.4:GOTO2110
2100 C(2)=C*.4:GOTO2110
2110 IFZ=1 THENB(3)=5900*.45:GOTO2130
2120 C(3)=C*.45:GOTO2130
2130 IFZ=1 THENB(4)=5900*.5:GOTO2150
2140 C(4)=C*.5:GOTO2150
2150 IFZ=1 THENB(5)=5900*.55:GOTO2170
2160 C(5)=C*.55:GOTO2170
2170 C(6)=C*.6:GOTO2190
2180 IFZ=1 THENB(6)=5900*.6:GOTO2190
2190 C(6)=C*.6:GOTO2190
2200 IFZ=1 THENB(7)=5900*.65:GOTO2210
2210 C(7)=C*.65:GOTO2210
2220 IFZ=1 THENB(8)=5900*.7:GOTO2230
2230 C(8)=C*.7:GOTO2230
2240 NEXT
2250 REM**TAX ALREADY DEDUCTED**
2260 FOR=1 TO4
2270 B=B-B(R)
2280 NEXT
2290 REM**NET TAX PAYABLE**
2300 F=T-E
2310 PRINT"DO YOU WANT TO:--
2320 PRINT"1) DISPLAY ON SCREEN
2330 PRINT"2) PRINT OUT
2340 PRINT"3) END
2350 PRINT"PLEASE ENTER YOUR CHOICE (1-3)
2360 INPUTN:IFN<1 ORN>3 THEN2350
2370 REM**SCREEN DISPLAY**
2380 REM**00102380 3000 3500
2390 PRINT"PRINTING(R),R(R,C)=INT(G)
2400 PRINT"YOUR SELF WIFE"
2410 FOR=1 TO17:FOR=1 TO3
2420 IFZ=1 THEN2450
2430 NEXT:NEXT
2440 X=3
2450 GOTO2490
2460 PRINT"R(R,C)=INT(G)
2470 RETURN
2480 RETURN
2490 PRINT"TOTAL NET INCOME"
2500 PRINT"TOTAL NET INCOME"
2510 PRINT"TOTAL NET INCOME"
2520 PRINT"TOTAL NET INCOME"
2530 PRINT"TOTAL NET INCOME"
2540 GOSUB260
2550 IFZ=1 THEN2510
2560 FOR=1 TO8
2570 FOR=1 TO3
2580 IFZ=1 THEN2610
2590 NEXT
2600 NEXT
2610 REM**NEXT:
2620 IFZ=1 THEN2650
2630 FOR=1 TO17:FOR=1 TO3
2640 IFZ=1 THEN2680
2650 NEXT:NEXT
2660 PRINT"PRINTING(R),R(R,C)=INT(G)
2670 PRINT"YOUR SELF WIFE"
2680 PRINT"YOUR SELF WIFE"
2690 PRINT"YOUR SELF WIFE"
2700 PRINT"YOUR SELF WIFE"
2710 PRINT"YOUR SELF WIFE"
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2960 PRINT"YOUR SELF WIFE"
2970 PRINT"YOUR SELF WIFE"
2980 PRINT"YOUR SELF WIFE"
2990 PRINT"YOUR SELF WIFE"
3000 PRINT"YOUR SELF WIFE"

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(continued from page 86)

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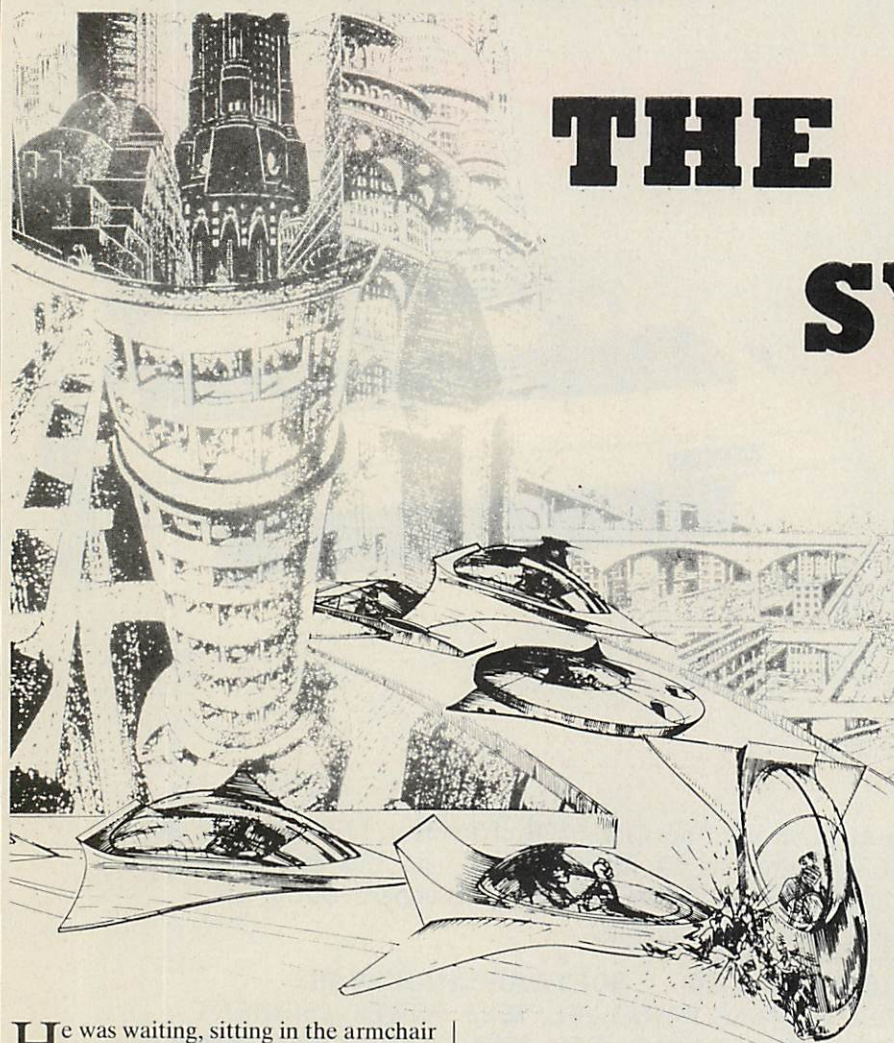
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CRASHING

THE

SYSTEM



He was waiting, sitting in the armchair and waiting. To be more accurate, he was slumped in the armchair with his legs dangling over one of the arms, watching the VDUs on the wall before him and controlling them through the keyboard on the other arm.

Waiting. His hand moved restlessly across the keys as he flicked from channel to channel. He was playing with time. He was waiting.

"No signal yet"? asked his mother, coming into the room.

"No".

"You know the time selection is random, you could wait for ever you know. Give me screen 4 for a moment, please".

He pressed the keys and transferred screen 4 over to his mother's manual board.

"Thank you".

He pretended to continue his search through the channels. He even set up a game, but in fact the Level 7 Invaderwar continued to play on automatic. He watched his mother interface with the supply computers and order some food and a shirt for his father. He was always intrigued when his mother shopped like this. He could stare at the catalogues for

ages without being able to make a decision.

She finished her orders and checked the updated balance at the bank.

"I must get your father to check our expenditure models", she mumbled, mostly to herself, and keyed that imperative into the personal memory file. She called up the family's nutrition charts for a moment, then flicked over to the news channel.

After absorbing some statistics on today's personnel movement projections

by Chris Waugh

she gave him back screen 4 complete with a defensive program for Level 7.

"Don't forget your B12s this week", she told him as she left the room and headed for the kitchen. He grinned to himself as he keyed in her defence program.

As he resumed his waiting, only the nervous movements of his hand usurped

the impression of total lethargy which settled again into all the nooks and corners of the screen room. He waited, as he had done for some days now, his glazed eyes seemingly oblivious to the flickering lights of the VDUs.

It was just past 1600 hours, and the grey winter's day was growing dim. The weather projection was for rain within the hour and that seemed an entirely appropriate expression of the day's events.

A signal on screen 3 had activated his body. As he cut the news he leapt into position bolt upright in the armchair, staring intently at screen 3 his eyes bulging. His listlessness was now replaced by intense concentration. Only his hand operating the armchair keyboard seemed to anchor the otherwise chaotic movements.

Screen 3 was distorting badly and the signal would not come through legibly. After trying the standard Signal Approach Programs he checked the system. Whilst the SAPs reran automatically on screen 3, the results of circuit checks and interference analysis came up on screens 1 and 2. His eyes moved mechanically from screen to screen as his hand played on the keys. As the negative check responses flashed up, he entered a Scramble/Code Signal Check.

He found himself waiting again, this time for the result of the S/CS check. Nervously he set up a game of Level 7 to fill the time, but his eyes strayed continually across to the blank space of screen 2.

He sat in the car and waited for a response to his request for route planning and clearance. During the rush-hour it could take up to five minutes for a request to be processed and granted.

As he waited, he tapped a rhythm on the driving console and thought about the news item he had seen earlier about personnel movement. The details having slipped his memory, he turned into the Newsummary channel and indexed PMP.

He read the transcript of the news item and wondered what PM levels were like

five years ago. He had no idea, and the Department of T-CoP's memory problems grew distant as he relaxed his focus on the VDU. The figures flowed into each other and the projections meant nothing. He was nearly asleep, but his hand was still tapping the console.

"You have positive RP and C on your PM request. If you wish to cancel your application please state updated intention immediately. Otherwise your PM will commence as soon as planned. Thank you".

The electronic voice had startled him, but he was fully alert again and waiting to leave. Waiting, always waiting.

Stretched out on the circular couch which filled the rear of the car, playing Level 7, it was some time before he noticed the frequency with which he was getting involved in traffic jams. One always anticipated a few hold-ups on the feeder lanes, but the through routes were usually fast-moving. A particularly long hold-up eventually registered in his mind, and he sat up.

Drops of rain were gradually covering the windscreen, and through this distortion he glimpsed something he had always regarded as being impossible. He fairly leapt from the couch to the control console, his fingers instantly in place on the keys and working to call the information which would explain what he saw. He finished keying and as he waited for the computer response he activated the windscreen wipers.

The information he received through the windscreen was of little use to him: there was too much of it for him to process. He could see a jam of vehicles: a single jam, which stretched away before him along the feeder lane and continued down the through route as far as he could see. The same jam blocked the overhead relief lane under which he was stuck. Other feeder lanes behind him and a subsidiary to his own were clogged with stationary vehicles.

He surveyed the spectacle before him for some time, for once unresponsive to the flashings of the VDU on the control console in front of him. His face, after registering the initial shock, was now a blank. Even when he found himself staring into the eyes of a girl in the car stuck beside his, that steely blankness remained unchanged.

Eventually he recovered sufficiently to consult the information which had been flickering before him for some time. The life came back into his fingers. The update on his particular PM was "delay of unspecified duration". No reason was forthcoming, and the overall PMP was unavailable. The rest of the information he received was irrelevant, so he turned to the news update. On no channel could he find any reference to PM problems. Even more confused than before, he

returned to the back of the car and lay on the couch.

For a while he lay and waited. Outside the car, all was still except for the rain. Inside, only the tapping of his fingers disturbed the atmosphere of calmness. Soon bored, he idly entered the Basic Information and Definition Index and keyed in "Dept. of T-CoP". The response was instant.

Department of Traffic Control Programming (T-CoP), The

This department replaced that of TP (Traffic Planning) in 1994 when the latter's future PM requirement projection came to be considered too inaccurate. It was decided that the only solution to the problem of mass viable PM was a central processor which planned and controlled all PM. Thus the whole concept of PM changed overnight — suitable time having been allowed for the conversion of vehicles to centralised automatic operation. Individual manual operation is now only needed in a few sparsely populated areas, which are outside the system controlled by the department's central processor.

It is estimated that in 1996 the system was already 40 percent more efficient timewise, 32 percent more efficient fuelwise, 74 percent more efficient total running-costwise...

He decided to cut the rest of the statistics. Of course it was all totally familiar to him, but somehow he required the confirmation of the existence of this remarkable system. The Index went on to state that "it is generally accepted that nowadays uncontrolled PM based on individual manual operation would be impossible" and he had never accepted anything else. He had been stationary in this one hold-up for nearly half an hour now, and that was a unique event in the history of the Department of T-CoP. It made him uncomfortable.

He decided to check his instructions again, not that he had not done so several times before he left home, but rather he sought some kind of comfort. Reality, perhaps, only confirms itself in the iterative statement of its being.

A-Maze Games Incorporated Presents...

The ultimate computer game...

The Labyrinth of Reality!!!

Why play with time when you can play though time? Why play on a screen when you can play in 3D space? Why interact with pictures when you can interact with people?

The Labyrinth of Reality Instruction One.

Access PM to PH5618/763L immediately. You will receive further instructions whilst you are travelling.

Signal reference as before.

And that was that. He wondered if his progress was being measured somehow and whether that would affect the timing and even content of his next instructions. Of course, he had no idea and his attempted speculations chased their own tails into a void.

The Labyrinth of Reality, developed in response to demand for leisure activ-

ity, was a game which was unique to each participant. The participant's own talents and resourcefulness were major factors in the game. Early movements in this direction included games where the computer selected at random one of a number of activities which the participant then undertook. Increasing degrees of complexity had been added to this basic framework and so, eventually, the first version of Labyrinth was born.

In theory, all participants are entered in the game computer. The machine allocates various adventures and activities to different people and groups of people. Each person receives instructions and at "game points" these instructions instigate the interaction of two or more participants in one or more events. The result of each interaction is fed back to the game computer which uses this continual update to calculate the next set of instructions.

The game is extremely fluid, existing in real-time and space. By necessity, it is totally secret. It is also claimed, by A-Maze Games, that spontaneous interactions develop and are often indiscernible from game computer co-ordinated interactions. Enrolment in the game can take place at any time simply by responding to advertisements on the commercial channels. Once the enrolment information has been input, the participant awaits confirmation and the instructions which follow at an unspecified time.

Most people only play a game on a part-time basis, having told the computer when they would be available. A-Maze Games stresses that it is secrecy that makes such flexibility possible, as it is the condition for most aspect of the game.

He found himself staring blankly at the girl in the next car, who returned his stare with equal blankness, when he received his next Labyrinth instruction.

"Your destination is unchanged.

"Instruction update requires that you make contact with the girl in the next car beside yours and bring her with you to your destination.

"Instruction updates continue on this signal reference".

For some reason, convinced of a necessity for immediate response, he got out of the car. The unusual turn of events struck him more as a malfunction than a unique happening. His Labyrinth instructions, under these circumstances, assumed the robes of order rather than adventure.

The girl, like him, was in her late teens. She seemed surprised by his action. At first she refused to let him into her car and would only talk to him with the window lowered half-way.

"Are you in the game, too"? was his opening question.

"Sorry, what game"? He looked up

(continued on next page)

(continued from previous page)

and down the queue of cars, and while no one could hear him, he was certainly the centre of attention.

"You know, Labyrinth. Is this meeting in your instructions?"

"Look, if this is your idea of a casual conversation . . ."

"No, you must have heard of Labyrinth — the game, you know". He looked imploringly at her, unable to find more words. He was earnest but wholly out of his element. That much, at least, she could tell.

"OK, yes, I'm in the game and yes this is in my instructions, but I'm not supposed to admit that, it's supposed to be up to you to persuade me to go with you. But after sitting in this mess for an hour I don't feel like playing too many games. So, we've met, what do we do now?"

"Wait", he said smiling.

He had been leaning on the car, bending down to talk at the window. Now he stood up straight in the orange glow of the lamplight. He looked up and down the queue of cars as he had done before, except that now he felt strangely relaxed. He was waiting once again, yes, but he was sure that his waiting was leading to something significant. The rain had turned into a thin drizzle and in the distance he thought he could see the red tail-lights of cars, moving.

When he awoke it was still dark. He listened but could hear no rain. On the control console an orange light was flashing. He looked across at the figure of the girl. She was still asleep. He sat up as the events of the night gradually returned.

The jam had cleared and they had sped off into the darkness of the countryside. For some time they had talked and played games, always speculating on what their next instructions might contain.

The memories faded into action. He sat before the control console and responded to the orange light. This was a signal to indicate that the destination had been achieved, as programmed. He asked for a site report on the destination and then disengaged the vehicle from T-CoP. As he waited for response, he turned round to look at the girl. She was just beginning to stir.

Small green letters informed him that his programmed destination had been one of the system exists, and therefore that was where he was now. System exists were those points where roads left the area controlled by T-CoP, giving access to those few areas where individual manual operation was still allowed.

"Where are we now"? asked a sleepy voice behind him.

"We've achieved our destination. It's one of the system exists. No instruction update as yet".

Almost as he finished speaking, the VDU began to print out a message which

he immediately recognised as an instruction update.

Drive down this road for approximately two miles. You will arrive at a crossroads. This is your destination.

At this site there is a ruined building. There you will find a riddle which, once solved, will give you a clue.

Waste NO time.

Instruction update on this signal reference.

Although he had been taught to drive, he had never had to do so in order to get somewhere. He mastered this necessity with surprising speed, and soon they arrived at the crossroads.

He keyed a request into the console.

"Well", he told her. "It will be dark for another hour. Sunrise will be in an hour and 21 minutes. Weather will continue to improve and tomorrow it will be quite warm and sunny".

"Shall we explore, then"? She need not have asked. The instructions had said "waste no time", and anyway they were both curious to a point where all other considerations were excluded. So they left the car and began to explore.

The ruins were those of a church. Overgrown with brambles and roofless, to them it was just a strange old building. They found a clearing in what would have been the chancel, and doubled their search for the riddle. Having found nothing, they eventually sat on a step and discussed their next move.

"I thought the thing we're looking for would be in some obvious form", she said. "You know, words or numbers or something like that. But all I can find is damp, crumbling walls, soaking wet vegetation and . . ."

She broke off with a shout, and pointed through a gap in the masonry to where a line of lights were approaching the ruin. The light was not the familiar beam of hand-torches or headlights, but of flame.

Half-afraid, and half-convinced that this was the riddle, they extinguished their own lights. Not daring to move, they found themselves holding on to each other for security. The lights approached and they could discern the dim shapes of the advancing group, each one bearing a light. They filed into the clearing, forming a circle around the two frightened people.

There was a silence, a pause, and then a woman, spoke.

"Our instructions were simple, nevertheless you followed them. In several months you are the first to have come this far. You are the first whose desire for satisfaction has been strong enough to overcome the lethargy of the time.

"You have heard of us in two ways. You think we are A-Maze Games who juggle with people's lives in an attempt to bring them some genuine excitement, and indeed we are the people responsible for The Labyrinth of Reality. But we are also the people responsible for that T-CoP

failure you experienced earlier. In fact we used one to engineer the other.

"We are also responsible for those programming problems on Diana Six and a number of other minor malfunctions which do their best to disturb the sterile perfection of our lives. We are responsible for trying to nudge people from security".

"Then you are members of CRASH", the girl replied. "And what are we, hostages or sacrifices"?

"You have heard of us". There was a tone of approval in the woman's voice. "You are neither. You are here because deep down you wish to join us, because you know the only adventure which satisfies is a real one. Labyrinth of Reality is nothing to this".

"We must have time to think, at least, I must". "Of course", she turned to him, "And what about you"?

He was not paying attention any more. It was all happening too fast for him to understand the implications of any decision.

"You too need time to think, I would say. It's a capacity which you will find takes time to develop, but is well worth it in the end".

He looked up. Through the ruins of a window he could see the first beams of sunrise penetrating the morning mist.

Eric waited patiently, sitting before his treasured invention. It was not unusual for decisions to take some time to be made. After all, it was a rather complex piece of machinery, even if he did think so himself. After two years of research he was more interested in the machine and its programming than anything to do with the stories it produced.

As he waited for the story to continue, he stared out of the window and contemplated the program. There were several areas he needed to expand. His attention was drawn back to the computer some minutes later by a soft crackling noise. He looked at the back of the machine to where the sound was coming from.

A shower of sparks spilled out of the casing from a short circuit inside. Before he had time to recover from the shock, a flame sprang up inside the machine and dark, choking smoke began to pour out.

"Oh my God"! he screamed. He tried to smother the flames but already they had spread to his papers on the bench. The screen was going haywire.

It was the laboratory assistant who pulled Eric from the room, and in the nick of time too. Minutes later the side of the building was torn open by an explosion which would most certainly have killed anyone left inside.

Eric watched the activities of the Fire Brigade while his hands were being expertly bandaged. Two years work was lost; he doubted whether it could ever be repeated.



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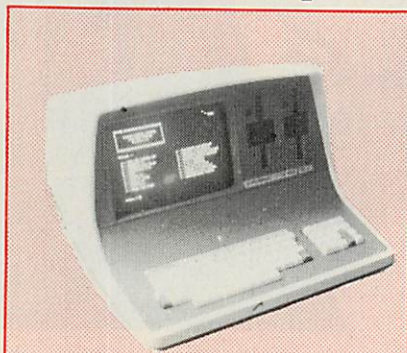
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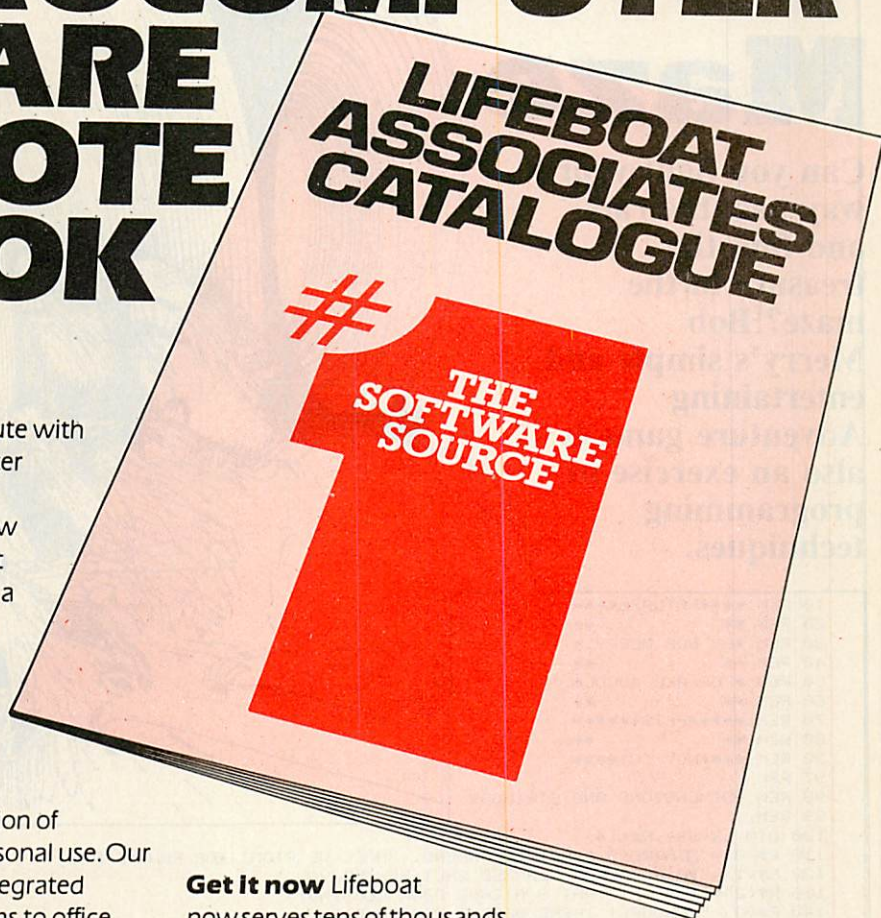
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The array as it would look for the start of figure 1 is shown in figure 2. However, this method contains a lot of redundant information. The regular structure of the

bers, used, as this is one of the junction numbers, zero cannot be where there is no connection an out-of-junction to which it is connected, and Each element holds the number of the other, 0 to 5, represents the directions. 99, represents the junctions and the store the maze data. One dimension, 0 to dimensional array, such as L(99,5), to The original idea was to use a two-dimensional array, such as L(99,5), to

indicates up and * indicates down. In the diagram the symbol 0 and down. In the diagram the symbol 0 connect to its neighbours in up to six directions: north, south, east, west, up and down. In the diagram the symbol 0 indicates up and * indicates down. In the diagram the symbol 0

The four levels

The maze used in Ratmaze has 100 junctions arranged in four levels, each consisting of a five-by-five square. A typical layer is shown in figure 1 — this is not one of the layers in the game itself, but serves to illustrate how the techniques were developed. Each junction can connect to its neighbours in up to six directions: north, south, east, west, up and down. In the diagram the symbol 0 indicates up and * indicates down. In the diagram the symbol 0



Rat Maze

Can you fight your way past the rats and find the treasure in the maze? Bob Merry's simple and entertaining Adventure game is also an exercise in programming techniques.

```

10 REM *****RATMAZE*****
20 REM **
30 REM ** BY BOB MERRY.
40 REM **
50 REM ** FOR ALL 40COL.
60 REM **
70 REM *****PETS*****
80 REM **
90 REM **
91 REM *****NOV '81*****
92 REM **
93 REM **
94 REM **
95 REM **
96 REM **
97 REM **
98 REM **
99 REM **
100 DIM L%(99),R$(14)
110 R$(0)="THERE'S A RATPACK AHEAD. SHALL WE FIGHT FOR RUN (F/R)?
120 R$(1)="OH DOOR HAS SLAMMED SHUT BEHIND YOU."
130 R$(2)="OH-OH! THAT'S A CAGE DOOR CLOSING!
140 R$(3)="BHOOPS! THERE GOES A PORTCULLIS!
150 R$(4)="GHEV! WE'RE FALLING INTO A PIT!
160 R$(5)="GHEV! WE'RE FALLING INTO A PIT!
170 R$(6)="GHEV! WE'RE FALLING INTO A PIT!
180 R$(7)="GHEV! WE'RE FALLING INTO A PIT!
190 R$(8)="GHEV! WE'RE FALLING INTO A PIT!
200 R$(9)="GHEV! WE'RE FALLING INTO A PIT!
210 R$(10)="GHEV! WE'RE FALLING INTO A PIT!
220 R$(11)="GHEV! WE'RE FALLING INTO A PIT!
230 R$(12)="GHEV! WE'RE FALLING INTO A PIT!
240 R$(13)="GHEV! WE'RE FALLING INTO A PIT!
250 R$(14)="GHEV! WE'RE FALLING INTO A PIT!
257 REM
258 REM ** INSTRUCTIONS+
259 REM **
260 PRINT "*****RATMAZE***** BY BOB MERRY
270 PRINT "PRESS 'I' FOR INSTRUCTIONS OR 'S' TO
280 PRINT "START" : GOTO 130
290 IF R$(0)="S" THEN GOTO 130
300 PRINT "THE OBJECT OF THE GAME IS TO FIND A
310 PRINT "TREASURE HIDDEN IN A MAZE OF TUNNELS.
320 PRINT "IT IS GUARDED BY FIERCE RATPACKS. YOU
330 PRINT "MAY RUN FROM THEM BUT WILL HAVE TO
340 PRINT "FIGHT SOME IF YOU WANT THE TREASURE.
350 PRINT "IF THEY MOUND YOU, YOUR AGILITY WILL BE
360 PRINT "REDUCED, WHILE THE EFFECT OF FIGHTING
370 PRINT "FOR HANDLING TOO LONG IN THE MAZE WILL
380 PRINT "WEAKEN YOUR STRENGTH. SOME TUNNELS LEAD TO
390 PRINT "DEADLY TRAPS. ALL YOUR DECISIONS ARE
400 PRINT "MADE BY PRESSING SINGLE LETTERS. NOW
410 PRINT "PRESS 'S' TO START.
420 GOTO 130
430 PRINT R$(14)
437 REM
438 REM ** DATA FOR MAZE TUNNELS+
439 REM **
440 DATA 16,56,56,56,18,18,120,72,64,34,34,40,96,34,96
441 DATA 80,74,80,72,0,48,24,26,12,100,48,24,24,104
442 DATA 96,80,10,20,72,80,28,24,48,48,48,48,104
443 DATA 64,80,36,96,18,40,68,96,2,80,24,72,0,36,48,12,16,40
444 DATA 80,120,40,48,104,48,88,120,120,72,68,48,72,112,8,20,72,16,88,0
445 REM
446 REM ** LOAD DATA FOR TUNNELS AND RANDOM RATPACKS+
447 REM **
448 REM
449 RESTORE FOR:FOR I=0 TO 99
500 REPEAT L%(I):IF RND(1)>L%(I)+1

```

(listing continued on page 104)

maze means that any move north decreases the junction number by 5; a move south increases it by 5; going east adds 1; and west subtracts 1. Moving one level up decreases the junction by 25 and going down a level increases it by 25.

These characteristics can be built into the program itself so that the array only has to hold a series of Go/No-go statements — see figure 3. The next stage was to develop a program using this two-dimensional array. An old-ROM Pet cannot handle arrays with so many elements, so a version was developed using six separate arrays, one for each direction.

Both versions worked well and there is no reason why this technique cannot be used — indeed, something similar would have to be used to define a non-regular maze. Nevertheless, all those 0s and 1s, should be meat and drink to a micro, and it became clear that it must be possible to simplify the program by using them more directly.

Bit-by-bit basis

In the Pet, the And function is used to compare binary numbers on a bit-by-bit basis. It is also used to compare statements for simultaneous states of truth, for example,

```
300 IF A=64 AND R$="YES" THEN 1000
300 IF A AND R$="YES" THEN 1000.
```

The first part means "if A is true", and the computer accepts any positive value of the variable A to be true, and zero or negative values to be false. This abbreviated form is used in Ratmaze.

Logical And compares binary numbers in the following manner:

```
A=11010110
B=10001100
A AND B=10001100
```

The statement A And B results in a 1 bit wherever a 1 appears in both A and B in the same position; otherwise a 0 is generated.

Junction 26 from figure 3 can be expressed as a binary number:

```
011100
```

If you want to see if you can go north, you simply logical-And this with 100000. The result is 000000 — in logical terms, the condition is False — which means that you cannot go north from junction 26. To go south, you logical-And the same number with 010000. The result is 010000, so the condition is True and you can go south.

Reduced to binary

All the data for the maze can be reduced to a series of binary numbers, which can be held in a single array using their decimal equivalents. In the case of the maze in figure 1 the data in figure 3 can be reduced to the single numbers shown in figure 4.

There are only six directions that you can take at each junction, while eight-

digit binary numbers can be used to define them, so there is a little spare capacity in this system for holding other information. In Ratmaze program, one of the spare bits is used to show whether there is a rat pack at the junction to be cleared before you continue. This is shown by a 1 in the least significant bit, while the direction information occupies the following six bits. The most significant bit is unused.

In addition to the three-dimensional maze, the player has to face the rat packs which pop up from time to time. You can run away from them, but the program has been designed to place packs at some key junctions where these must be fought. Strength and agility ratings are included in the game. If either reaches zero, then the player loses.

The program starts by setting up two arrays. The integer array L%(99) contains the details of the maze, while the string array R\$(14) contains various phrases that are used; they are loaded into the array in lines 110 to 250. The page of instructions which follows uses the subroutine at 1130. Only letters contained in C\$ will cause the program to continue. While it is waiting for an acceptable response, it runs through random numbers to ensure a different game every time.

Integer array

After the instructions comes the Data statements for the maze. They are loaded into the integer array in lines 490 to 510 which also include a simple random placing of rat packs, indicated by setting the least significant bit to 1. Lines 520 to 560 place rat packs at five key junctions, if they are not already there. This is checked by seeing if the least significant bit is 1 or 0:

```
IF (L%(12) AND 1)=0 THEN...
```

Line 570 sets to zero the four variables corresponding to strength S, agility A, current location L and possession of treasure TR. It also defines a simple function used to generate random numbers in the range 0 to X.

During the game line 590 determines whether or not there is a loss in strength and it is to this point that the program loops at each junction. To avoid losing strength during the first run through in a game it is by-passed by line 580.

In lines 600 to 660 the appropriate element of the integer array is inspected and the available directions are printed. This routine uses the And function.

Now the players make their choice using a single-letter response. All six directions are included in the permitted responses C\$, but you need to check whether the chosen response is valid for the junction in question. If it is, the necessary change to the location number must be made in lines 680 to 740. Line 740 is only reached if all the tests in the previous lines are failed.

Line 750 modifies the location number and checks to see whether the number of the new location is divisible by 25. There are four traps in the maze from which there are no exits: they are the ones which are zero in the data statements and are set at regular intervals in the maze. If the player moves into one of them the program diverts to line 870, which determines which of the traps you have fallen into and prints the appropriate elements from the array R\$(14). Line 880 prints end-of-game messages, and 890 to 900 give the option of another game.

Check for rats

If the traps have been avoided the program checks for the presence of a rat pack, and branches forward to 810 unless it is present. This line is a means of checking whether L is zero — signifying the Exit location — since any non-zero value is logically true, causing the program to loop back to 590. If however L is zero, you are at the Exit and success then depends on whether you have found the

(continued on next page)

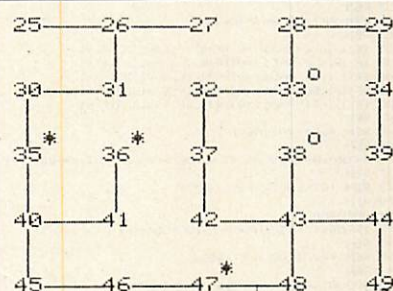


Figure 1.

Element	5	marker	Direction	Junction
25	—	—	26	—
26	—	31	27	26
27	—	—	27	—
28	—	33	29	—
29	—	34	—	28
30	—	35	31	—

Figure 2.

	0	1	2	3	4	5
	N	S	E	W	U	D
25	0	0	1	0	0	0
26	0	1	1	1	0	0
27	0	0	0	1	0	0
28	0	1	1	0	0	0
29	0	1	0	1	0	0
30	0	1	1	0	0	0

Figure 3.

Junction	Value
25	8
26	28
27	4
28	24
29	20
30	24

Figure 4.

(continued from previous page)

treasure — the condition $TR=1$. If not, you have the option to re-enter the maze immediately or quit.

When you encounter a rat pack the first choice is to fight or run. The choice to fight causes a branch to 920; running takes you to 790. Line 790 first backtracks to the previous location, using the modifier still in M. Of course, running away can have its dangers; and if your agility has fallen below 50, subroutine 1240 is called and a random number of wounds — up to 8 — are inflicted. This is reported to you in lines 1250 to 1260, and your agility is further reduced by up to this number of wounds. If A falls below 1, the game is over and this is reported by lines 1170 and 880 to 910.

When you choose to fight, line 920 sets the size of the rat pack to between 10 and 30 rats. They will attack you in waves of five rats at a time, and you will be given the choice of Lunge, Cut or Dodge. A lunge is guaranteed to kill one rat; a cut can kill more, dependent on your

strength, but you may also miss entirely. Dodging will reduce the number of wounds you take, but it depends on your agility, as does the ability to make several cuts in succession.

Loss of agility

The choice of response is made using subroutine 1180, and lines 930 to 950 branch to the appropriate part of the program. Line 960 makes the one kill for the Lunge option and this is reported by subroutine 1200. Line 970 then gives the choices for continuing the fight. Making a cut depends on agility, but you can always try to dodge. If you try to continue with another lunge, or if your attempt to cut fails, then the rats get too close and all of them wound you, resulting in a loss of agility in subroutine 1260.

The Cut option starts at line 1000, which allows you to kill a number of rats determined by your current strength. Cutting could also sap your strength, so the next line allows for a random loss of strength. As with the loss of strength

when moving about the maze, this could reduce your strength to zero, so this is checked in subroutine 1290.

If all the rats in that wave have been destroyed then the program branches to 1060, where the subroutine to print out S and A is called and the size of the rat pack is checked to see whether there is enough for another wave. Eventually the size of the rat pack will be reduced to four or less, and that location can be cleared of rats by line 1090.

The other option you have is to dodge, and this is covered in lines 1040-1050. This option reduces the number of wounds suffered according to agility, but the rest of that wave gets through and subroutine 1260 reports the number of wounds.

There will always be a rat pack at the treasure location, so you check for this location at the end of the fight sequence before continuing the movement through the maze. Subroutine 1230 is simply a delay to allow you to read some reports before they disappear from the screen.

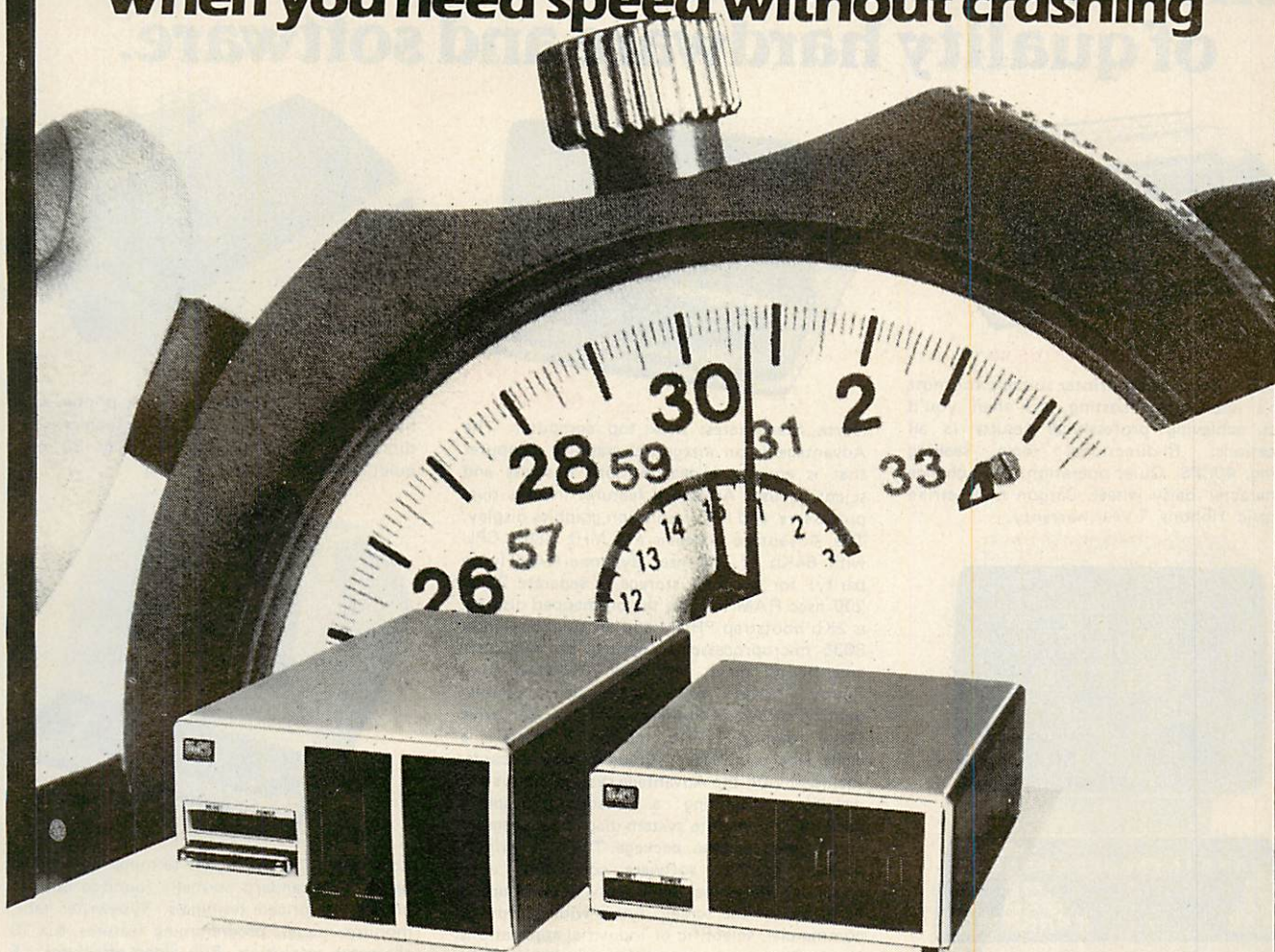
(listing continued from page 102)

```

510 NEXT
511 REM
512 REM
513 REM +FIXED RATPACKS+
514 REM
515 IF(L<(12)&AND1)=0THENL<(12)=L<(12)+1
516 IF(L<(32)&AND1)=0THENL<(32)=L<(32)+1
517 IF(L<(37)&AND1)=0THENL<(37)=L<(37)+1
518 IF(L<(56)&AND1)=0THENL<(56)=L<(56)+1
519 IF(L<(81)&AND1)=0THENL<(81)=L<(81)+1
520 REM
521 REM +SET VARIABLES+
522 REM
523 S=100:A=100:L=0:TR=0:DEFNAC(X)=INT(X*AND(1)+.5)
524 REM
525 REM +STRENGTH REDUCED?+
526 REM
527 GOT0600
528 IFNAC(1)=1THENS=S-.5:GOSUB1290
529 REM
530 REM +AVAILABLE TUNNELS+
531 REM
532 GOSUB1160:PRINT"YOU CAN GO ";
533 IFL<L&AND64THENPRINT"NORTH ";
534 IFL<L&AND32THENPRINT"SOUTH ";
535 IFL<L&AND16THENPRINT"EAST ";
536 IFL<L&AND8THENPRINT"WEST ";
537 IFL<L&AND4THENPRINT"UP ";
538 IFL<L&AND2THENPRINT"DOWN ";
539 REM
540 REM +SELECT DIRECTION - CHECK VALIDITY+
541 REM
542 PRINT:PRINT"WHICH WAY (N/S/E/W/U/D)?":C$="HSEHJD":GOSUB1130
543 IFR$="N"AND(L<L&AND64)THENM=-5:GOT0750
544 IFR$="S"AND(L<L&AND32)THENM=5:GOT0750
545 IFR$="E"AND(L<L&AND16)THENM=1:GOT0750
546 IFR$="W"AND(L<L&AND8)THENM=-1:GOT0750
547 IFR$="U"AND(L<L&AND4)THENM=25:GOT0750
548 IFR$="D"AND(L<L&AND2)THENM=25:GOT0750
549 PRINT"YOU CAN'T GO THAT WAY. TRY AGAIN":GOT0670
550 REM
551 REM +MAKE MOVE - CHECK FOR TRAP+
552 REM
553 REM
554 L=L+M:IFINT((L+1)/25)=(L+1)/25THENS=70
555 REM
556 REM +CHECK FOR RATPACK+
557 REM
558 IF(L<L&AND1)=0THENS=10
559 REM
560 REM +FIGHT OR RUN?+
561 REM
562 PRINT$(0):C$="FR":GOSUB1130
563 IFR$="F"THEN920
564 REM
565 REM +RUN OPTION+
566 REM
567 REM
568 L=L-M:IFAC50THENGOSUB1240
569 GOT0590
570 REM
571 REM +AT EXIT?+
572 REM
573 IFLTHEN590
574 PRINT"THIS IS THE EXIT!"
575 REM
576 REM +WITH TREASURE?+
577 REM
578 IFTR=1THENPRINT"WELL DONE!!! YOU'VE WON!":GOT0910
579 PRINT"YOU HAVE NOT GOT THE TREASURE. DO YOU WANT ANOTHER GO (Y/N)?
580 C$="YN":GOSUB1130:IFR$="Y"THEN590
581 GOT0910
582 REM
583 REM +END OF GAME IN TRAP+
584 REM
585 X=INT((L+1)/25):PRINT$(X):PRINT$(X+4)
586 PRINT$(9):IFTR=1THENPRINT$(10)
587 PRINT$(13):C$="YN":GOSUB1130
588 IFR$="Y"THENPRINT$(14):GOT0430
589 END
590 REM +FIGHT OPTION+
591 REM
592 RP=10+FNA(4)*S:PRINT"HERE THEY COME!
593 REM
594 REM +CHOICE OF RESPONSE+
595 REM
596 RA=5:GOSUB1180:IFR$="L"THEN560
597 IFR$="C"THEN1000
598 GOT01040
599 REM
600 REM +LUNGE OPTION+
601 REM
602 RP=RP-1:K=1:RA=4:GOSUB1200
603 GOSUB1180:IFR$="C"ANDRND(1)*AC>30THEN1000
604 IFR$="D"THEN1040
605 PRINT"THEY'RE TOO CLOSE!":M=RA:GOT01050
606 REM
607 REM +CUT OPTION+
608 REM
609 K=INT(FNA(RA+1)*(S-1)/100):RP=RP-K:RA=RA-K:GOSUB1200
610 S=S-FNA(2):GOSUB1290
611 IFRA=0THEN1060
612 GOSUB1160:GOT0970
613 REM
614 REM +DODGE OPTION+
615 REM
616 D=INT(A/25+.7):M=RA-FNA(D):IFWC0THENM=0
617 GOSUB1260
618 REM
619 REM +END OF FIGHT?+
620 REM
621 GOSUB1160:IFRP<4THEN1080
622 PRINT"MORE RATS ATTACKING!":GOT0930
623 PRINT"YOU'VE KILLED MOST OF THEM AND THE REST HAVE RUN OFF!
624 L<L<L-1:GOSUB1230:IFL=0THEN820
625 REM
626 REM +AT TREASURE?+
627 REM
628 IFL<370TR=1THENS=90
629 IFL<370TR=1THENS=90
630 PRINT"YOU'VE FOUND THE TREASURE! NOW YOU MUST GET OUT.":TR=1
631 GOSUB1230:GOT0590
632 REM
633 REM +SUBROUTINES+
634 REM
635 REM +GET REPLY+
636 REM
637 GET$(P=AND(1):IFR$=""THEN1130
638 FORI=1TOLEN(C$):IFR$=MID$(C$,I,1)THENRETURN
639 NEXT:GOT01130
640 REM
641 REM +PRINT STRENGTH/AGILITY+
642 REM
643 PRINT"STRENGTH: ";INT(S);TAB(20);"AGILITY: ";INT(A);RETURN
644 REM
645 REM +END OF GAME WITH ZERO S OR A+
646 REM
647 PRINT$(R):GOT0980
648 REM
649 REM +LUNGE CUT OR DODGE?+
650 REM
651 IFR=0 DO YOU WANT TO LUNGE, CUT OR DODGE (L/C/D)?":C$="LCD"
652 GOSUB1130:RETURN
653 REM
654 REM +NUMBER KILLED+
655 REM
656 PRINT"YOU'VE KILLED":K:R$="IS":IFRA=1THENR$="ARE
657 IFRA=0THENRETURN
658 PRINT"FRAY!" STILL COMING!":RETURN
659 REM
660 REM +TIME DELAY+
661 REM
662 FORI=1TO2000:NEXT:RETURN
663 REM
664 REM +WOUNDS ON RUN+
665 REM
666 M=FNA(8):IFM=0THENRETURN
667 PRINT"YOU'RE NOT QUITE QUICK ENOUGH
668 REM
669 REM +REPORT OF WOUNDS+
670 REM
671 PRINT"YOU'VE SUFFERED":M"WOUND":IFWC4THENPRINT"S"
672 IFR=FNA(4):IFR<1THENR=12:GOT01170
673 RETURN
674 REM
675 REM +STRENGTH TOO LOW?+
676 REM
677 IFSC.5THENR=11:GOT01170
678 RETURN

```


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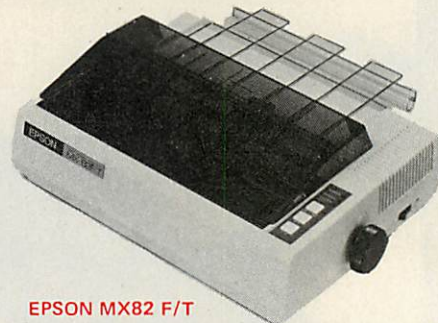
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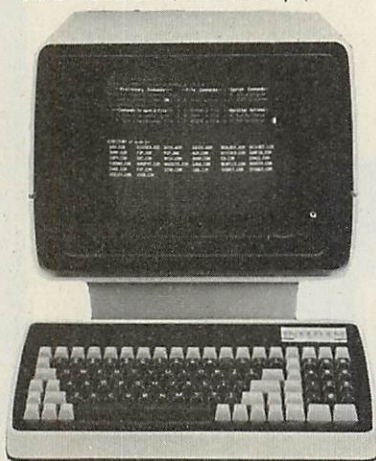
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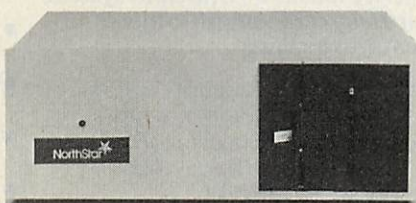
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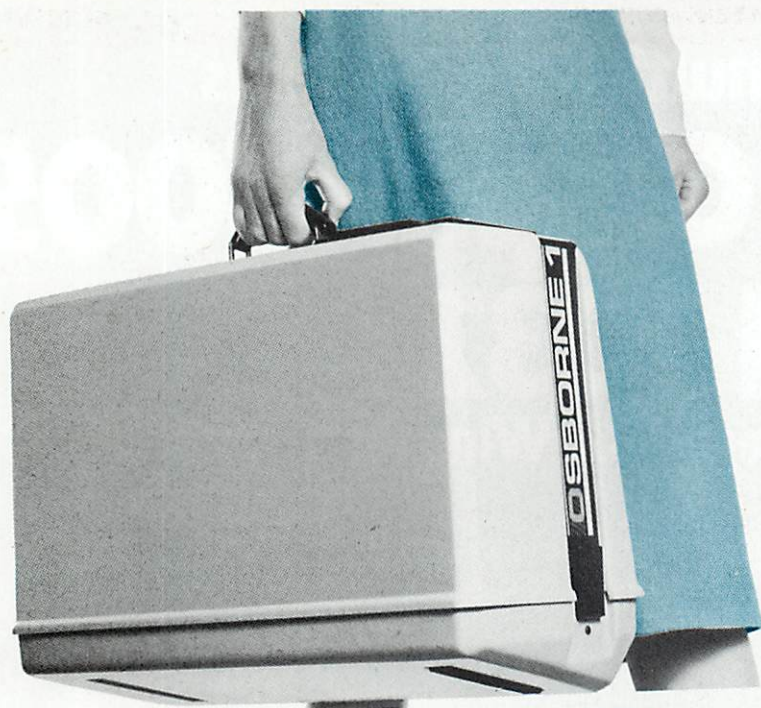
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THE DEVELOPMENT of microcomputers over the last year or two has featured one big ingredient which no user will have overlooked — processing ability is going up and cost is going down.

For the manufacturer this has produced a situation where the processor itself is no longer the main cause for concern. The peripheral units are a larger percentage of cost now, have the greatest influence on machine size and are likely to be the real limiting factor to processing ability.

The result is a demand for lower-cost fixed disc storage for microcomputers of a type previously only viable for larger business systems or minis. To answer these demands, disc drive designers are now tending toward compact products suitable for use in shared-logic systems. They tend to incorporate features formerly associated only with large, high-performance devices, especially in the "workhorse" 8in. size.

Multi-user systems

Capacity requirements are growing beyond the 15Mbyte typically offered in today's 8in. drives. Systems with access time of less than 50ms. will need to be acceptable for large multi-user office systems. At the same time, OEM disc-drive users cannot afford to pay twice as much for their peripherals, even if they get a two-fold improvement in capacity and performance. Cost per megabyte has in the past been in the range of £50 to £100 for 8in. Winchester drives.

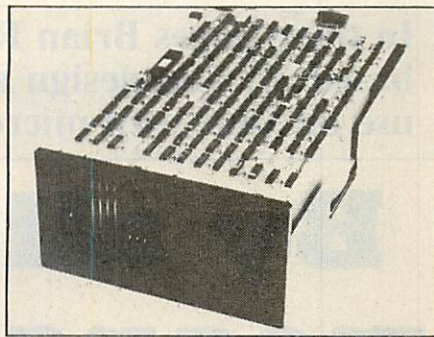
The trend toward higher performance in smaller drives has spurred the industry in recent months toward the development of higher-precision, closed-loop servo positioning mechanisms in addition to the already existing open-loop designs. They improve positioning precision and permit improved track densities and access times.

The Shugart Fastrak, for example, has positioning information pre-recorded on the bottom surface of the drive's bottom disc. Under the control of a single-chip microcomputer, the servo head, which is mounted on the actuator assembly, reads the servo information and positions the actuator over the correct cylinder. The actuator assembly mechanically couples the servo head to the data heads to improve positioning accuracy. The effects of mechanical and thermal tolerances associated with the typical stepper motor are thereby reduced.

Limiting factor

Position feedback is the key in this type of positioning system. The closed-loop servo system continually provides precise servo information which is used to position the data heads. The stepper motor, on the other hand, operates on a sequence of pulses. After 10 step pulses are sensed, for example, the data head should be on track 10; but there is no

The latest generation of hard discs store up to 35Mbyte on a single 8in. unit. Dave Brodsky of Shugart explains some of the technical innovations which have made this level of performance feasible.



Developing heads for more figures

positioning feedback signal to tell the system that it really is precisely on track 10.

The lower precision of the stepper motor positioner has been a limiting factor in increasing the track density of drives. Because the positioning is not as accurate, each track has to be wider to allow for the mechanical and thermal tolerances associated with the open-loop stepper principle. This remains acceptable for the low-cost drives used in smaller, stand-alone systems with capacity needs at around 15Mbyte or less, but the new larger and multi-user systems demand the increased performance.

Track density

With the new servo-controlled system and its improved positioning accuracy, track width is reduced by approximately two-thirds. For example, the track density is raised from 172 TPI on Shugart's original SA-1000 8in. Winchester drive, to 500 TPI on the new SA-1100. A two-platter drive with three available data surfaces provides 20.3Mbyte capacity, and a three-platter drive with five data surfaces provides 33.9Mbyte.

Because a closed-loop servo system correlates the overall seek distance with its actual position, an optimum acceleration/deceleration curve can be generated for each length seek, resulting in a low access time. In an open-loop actuator system, with no position feedback, more cautious movement is required and a 35ms. access time cannot be achieved.

There are other areas, too, where gradual design improvements are lowering manufacturing costs yet stepping up drive performance. In the drive itself, the DC motor gives speed control with a variation of less than one percent. Higher reliability comes from fewer mechanical parts and the elimination of a lateral load on spindle bearings from the belt normally associated with an AC motor. The electronics can also be simplified.

The Shugart SA-1100 drives — see photograph — have been designed with approximately 250 discrete components, arrayed on two printed circuit boards, and early production models are assembled in this form. Later models are to be offered with full custom LSI electronics, reducing the number of components to the under-60 range, and eliminating one of the two printed-circuit boards.

Another development which aims to improve reliability is the dedicated head landing/shipping zone, designed to prevent head and disc damage and provide maximum data protection. The heads are moved automatically to this zone when the drive is powered down, when DC power is lost, or when the disc is moving at less than 80 percent of normal operating speed. Once in the landing zone, the heads are held in place by an automatic actuator parking lock. An automatic spindle brake also keeps the disc from rotating when power is removed.

Design improvements

Design changes currently emerging from research and development departments involve few problems in upgrading from standard-performance 8in. Winchesters. For example, to upgrade to the Shugart SA-1100 from an SA-1000-based system, only minor hardware and software modifications are required. In the hardware area, a third head-select line already present in the read/write data cable must be activated. The device controller needs to access this line in order to address the five read/write heads on the three platter SA-1100 model.

The SA-1100 interface also includes two optional input signal lines not available with the SA-1000. One is a fault-clear line that clears unsafe conditions, such as a head drawing too much current. The other is a recall line that commands the selected drive to position the read/write heads to cylinder 0 and reset any seek-error conditions, a task formerly handled by the controller, which is now relieved of this burden. 

In these pages Brian Reffin Smith keeps you up to date with computer-based art and design and lays the foundations for graphics routines to use on your own micro.

By all means fool about

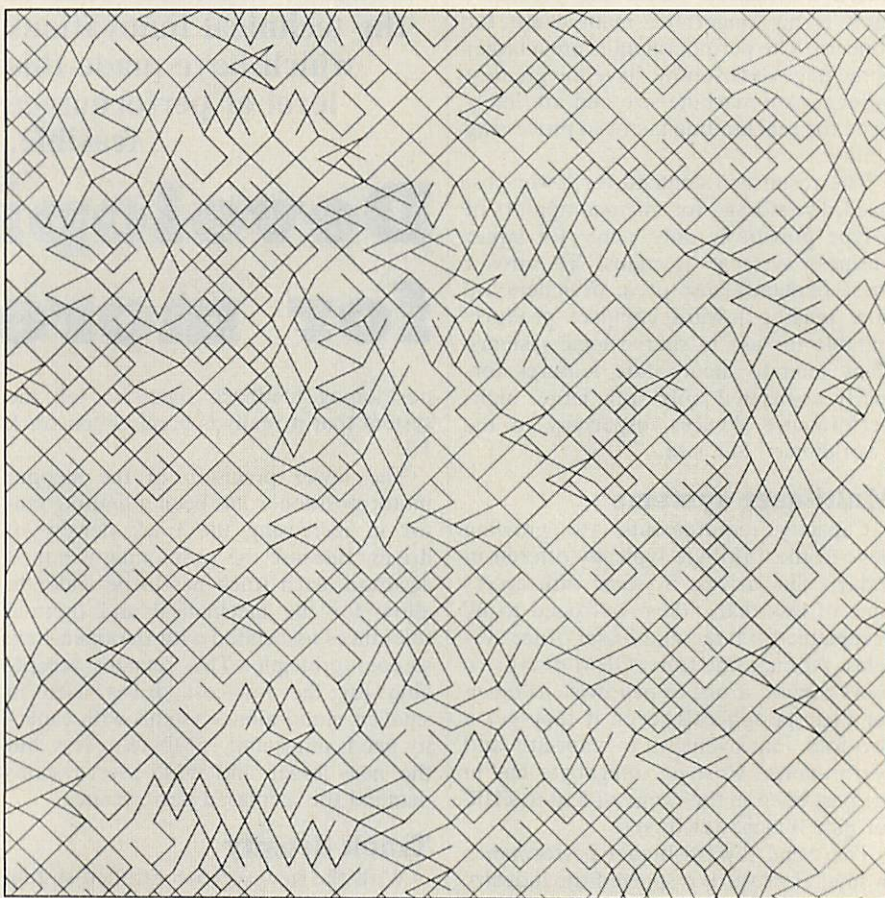
I RECENTLY organised a London show of artists and musicians who use computers in their work. Although the show has now finished in London, it is due to visit Paris, and later on Edinburgh — so if you are a jet-setter, or happen to live there, drop in and visit.

The title of the exhibition is "Artists/Computers/Art", which attempts to convey the fact that here is work done by artists, who just happened to be using computers. So much so-called "computer-art" hardly passes muster as art at all, and most art-oriented people are put off by it.

Happier each day

Jacques Palumbo has forsaken his native Algeria and now lives in Canada. His work, I must admit, is not in that category of art that I like most. But I wanted Palumbo in the show for an important reason: he has stopped using computers, at least for the time being. In his previous use of the technology in art, he is fairly typical of those who work with systems of numbers, translating them into some visual form. Permutations and systematic variations feature strongly, and no doubt you can think of many examples that have been seen over the years that use similar ideas.

Five frames illustrating a graphics sequence originated by Gerald Hushlack of the University of Calgary.



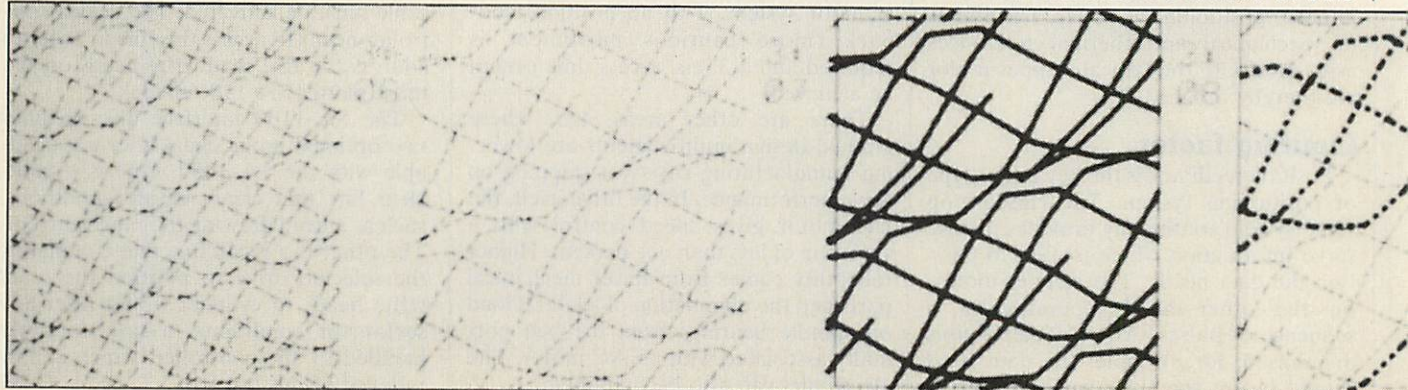
One of Jacques Palumbo's designs — nowadays he prefers to play guitar.

The fact that he has stopped and, as he now says, sits with his partner and "two marvellous children, playing classical guitar and Renaissance lute, getting a bit happier each day", is worth examination. For on one level, it would not be surprising that any human would prefer to do things like that, rather than draw lines on paper, whose positions correspond to some well-defined numerical progression or permutation.

Yet, the same person, surely not an entirely different being, became quite

famous as an artist for doing precisely that, and presumably gained satisfaction from it. He has said previously that he used computers to save him time, allowing the almost instant production of work that would have taken ages by hand. But after a period of this labour-saving approach, he gives up altogether. Could it be that the fact that he hand-drew his earlier work compensated for some other, inherent, sterility? If that is so, does it have any messages for us who use computers — for whatever reason — in our own work?

Gerald Hushlack is Professor of Fine



Art at the University of Calgary where he has access to some extremely powerful computing equipment. One reason for such riches of computer graphics devices is that the town is firmly based on oil production: the oil corporations make considerable use of graphics to help them visualise the endless streams of data produced by their many and various tests and explorations.

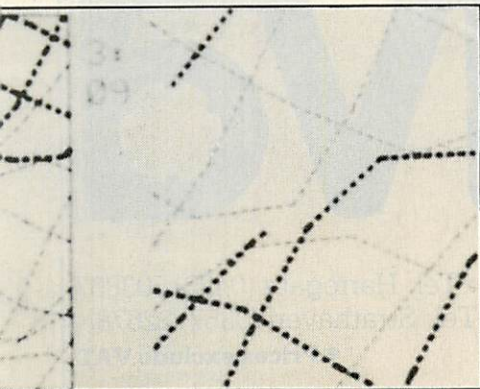
Boston Stranglers

Unlike Palumbo, Hushlack revels in using computers. I remember going out with him to drink several "Boston Strangers", a lethal local cocktail of which vodka, Tia Maria and cream were some of the less brutal ingredients. Suitably refreshed, we then slipped into the silent offices of an oil company to spend hours producing immense sheets of colour graphics. It must be said, however, that Hushlack also does a great deal of painting, and other hand-work too. Maybe that keeps him relatively sane.

Of his work, he says: "Traditionally, machines used in art-making functioned as tools performing only in an external mode". I think he means external to your head. "Today the computer can assist the artist at all levels: selection and organisation; instant visual playback of information; and an instant memory actively addressing data many years old. Most important of all are present software developments which allow subjective inclinations to become workable information for the artist. The artificial intelligence liberates the artist from the drudgery and laborious activities which are so often necessary in art-making. Possible solutions for determining quality may point in directions which require the redefinition of basic notions of art".

Vital enquiry

Yes indeed — and to see why the use of computers in art may be so important in general terms, you only have to change his final sentence to be about the use of computers in many other spheres. Art, by virtue of its "free" position to explore, play games, fool around and ask strange questions, may become a most vital mode of enquiry into the emerging information environment.



BEGINNING GRAPHICS Loops and turns

```
10 REM Universal 2D rotation A.Goodhew
20 REM For BBC Micro
30 MODE4
40 INPUT "Numbers of Corners:" N
50 DIM X(N),Y(N)
60 FOR I=1 TO N: "CORNER ":I: INPUT X(I),Y(I):NEXT I
70 P: INPUT "Centre of rotation - X,Y":CX,CY
80 P: INPUT "Clockwise rotation in degrees":R:R=R*PI/180
90 CLS: REM clear screen
100 GOSUB150: REM draw object
110 GOSUB170: REM rotate it
120 GOSUB150: REM draw image
130 END
140 REM Draw shape in X() & Y()
150 MOVE X(N),Y(N): FOR I=1 TO N: DRAW X(I),Y(I):NEXT I: RETURN
160 REM Rotate shape
170 FOR I=1 TO N
180 X=X(I)-CX: Y=Y(I)-CY
190 D=SQR(X*X+Y*Y): IF X=0 THEN A=PI/2: GOTO 210
200 A=ATN(Y/X)
210 IF X<0 THEN A=PI+A: GOTO 230
220 IF Y<0 THEN A=2*PI+A
230 T=A-R: X(I)=D*COS(T)+CX: Y(I)=D*SIN(T)+CY
240 NEXT I: RETURN
```

RATHER THAN introduce any new ideas, this month I want to present the winning entries from the first two competitions, published in the February and March "Art" pages. Other people's programs are always the richest source of graphics routines, and these two are no exception.

This is not to say, of course, that you can steal someone else's ideas wholesale and then go on to use them simply for

your own profit. But music, poetry and other forms of art progress through their practitioners changing, reacting to and, indeed, using the ideas of others. Computing can, and should, do the same.

After all, a For-Next loop is hardly copyright, nor are the by now well-known ways of manipulating shapes on screen or paper. These routines are, rather, the raw materials which the creative computer user exploits to put forward his or her ideas, using the medium of information technology.

As announced last month, John Hardman is the winner of the February competition which called for the best program or artwork based on a For-Next loop. He submitted two versions of his program — the one printed here is for the Research Machines 380-Z. His alternative program for the ZX-81 requires a high-resolution add-on for the micro in order to run properly.

One hopes that all microcomputers introduced in the future, regardless of price, incorporate proper high-resolution graphics capability. After all, what use is a computer without one? Not being able to use graphics to communicate information is rather like motor racing without cars: good for the soul, no doubt, and fine exercise for the drivers as they run round the track, but somehow lacking in finesse.

The competition in March called for a program which rotates a shape about any point by any angle. The winner of the £5 prize is A Goodhew of Eastrea, near Peterborough. We are printing here a version to run on the BBC Micro though the original was, very sensibly, written for the 380-Z.

The program asks for "corners" and puts values into two arrays X() and Y(). If you have access to any kind of digitising device, such as a light-pen, joystick or digitising pad, you will see that you could enter values into X() and Y() automatically.

```
10 REM JOHN HARDMAN
20 PUT12
30 CALL "RESOLUTION",0.2
40 FOR A=0 TO 85 STEP 5
50 X=128+96*SIN(A*.017453292)
60 Y=96+96*COS(A*.017453292)
70 LET I=224-Y
80 LET J=X-32
90 LET Q=256-X
100 LET W=192-Y
110 LET E=256-I
120 LET R=192-J
130 CALL "PLOT",X,Y,2
140 CALL "LINE",I,J
150 CALL "LINE",Q,W
160 CALL "LINE",E,R
170 CALL "LINE",X,Y
180 NEXT A
```

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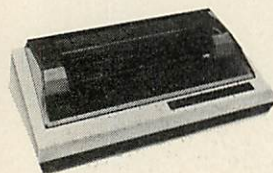
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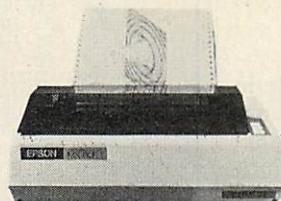
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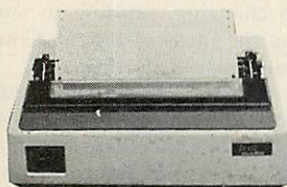
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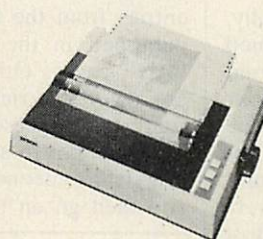
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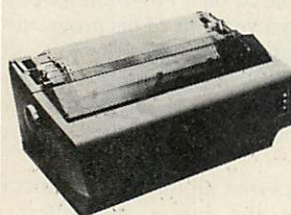


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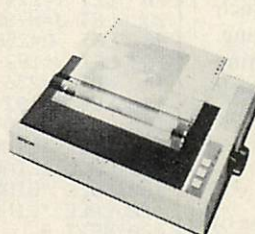
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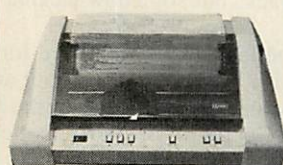


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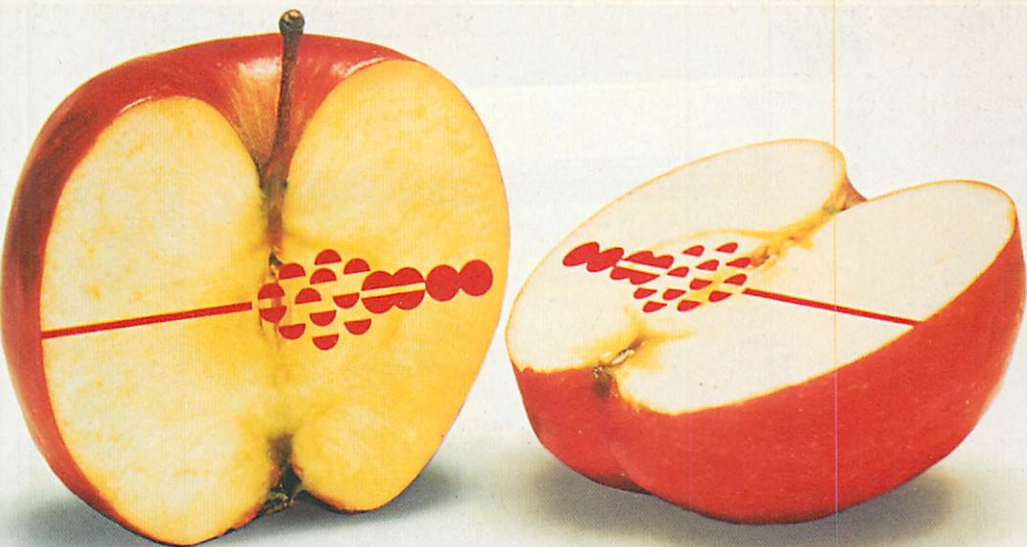
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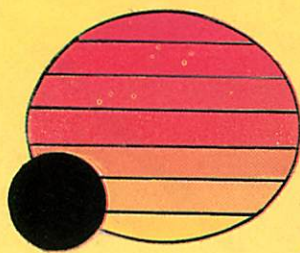
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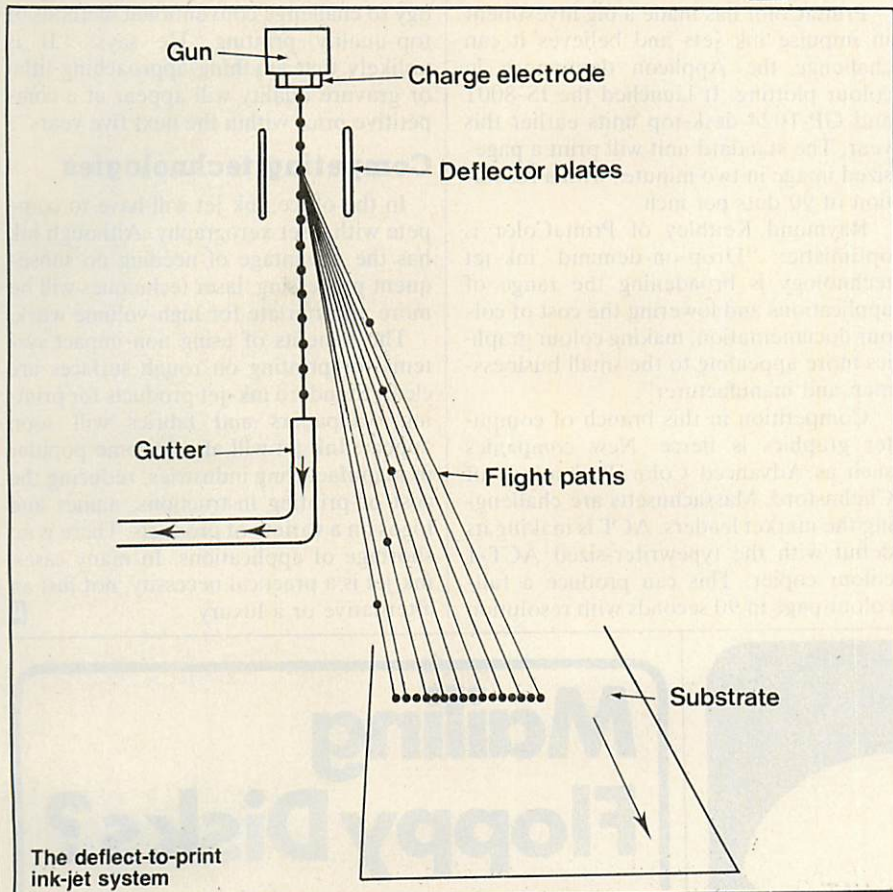
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Ink jet: a revolution in printing that will make no impact



The deflect-to-print ink-jet system

CAMBRIDGE LEPIDOPTERISTS are no longer surprised when they catch a butterfly which bears the marking "CCL" on its wings. The initials stand for Cambridge Consultants Ltd, one of the British firms who are developing the technology of ink-jet printing.

"Yes, most of the butterflies round here do have the company logo", admits director Steve Temple, cheerfully. "With inkjet you can print on the most delicate material without damaging it". Indeed, CCL has demonstrated that ink-jet techniques are ideal for printing on a whole range of unusual or sensitive surfaces because nothing touches the surface which is to be printed, the substrate, except the ink.

Charged droplets

These non-impact printers break up a flow of ink into minute droplets. The droplets are given small electrical charges which are controlled by a computer. The ink jet follows the computer's instructions, and each drop of ink is directed

A pen that never touches the paper is starting to make its mark. John Lewell explains how ink jets can print 20 metres of characters a second under complete computer control.

towards the substrate at a precisely calculated angle.

In the continuous-flow printer, the ink droplets are given individual electrical charges and are then directed by deflector plates which are maintained at a constant potential. Richard Sweet at Stanford University achieves this by deflecting the charged droplets to the substrate while collecting the uncharged droplets in a gutter. Another method, based on the work of Professor Hertz at the Lund Institute of Technology, is to apply the charge to those drops which are not required for printing, and to deflect them out of the way on to an earthed plate. Both methods require the utmost

precision to obtain acceptable resolution.

In the deflected-to-print system, ink is supplied under pressure to a gun which forces it through a nozzle. Inside the nozzle, which may be as small as 35 microns in diameter, the ink is modulated ultrasonically and breaks up into a series of equal-sized drops. These pass through a charge electrode, and a voltage is applied between the electrode and the drop stream.

The electrical charges vary according to the voltage level at the time when the drop separates from the stream. Every drop is thus given a predetermined charge and can be deflected at a calculated angle as it passes the deflector plates.

Until recently, ink-jet printing was restricted to simple tasks like printing addresses for mail-order companies or overprinting "stop press" items. Ironically, though the phrase "stop press" will doubtless continue to be used, ink-jet techniques allow you to change what is being printed without stopping the press — or, for that matter, without "pressing".

Quality improves

The technology was originally applied to alphanumeric printers where speed rather than quality was needed. Now full-colour computer graphics, acceptable both in quality and in size, can be printed.

A single ink jet will print only on to a very small area, so a number of them work side by side in one machine. The paper, or other substrate, moves at a controlled speed a few millimetres beneath the bank of nozzles. Both flat-bed and drum printers have been designed, and the system is even used in a few advanced typewriters.

The single-nozzle video jet alphanumeric printers made by A B Dick can produce 1,275 characters per second to a resolution of 30 to 70 points per inch. The finest resolution likely to be achieved over the next few years will probably not exceed 16 to 20 points per millimetre. IBM has a high-quality ink-jet document printer, the 6640, which is used in its System 6 word-processing package. This will print 92 characters per second with 10 points per millimetre resolution.

The alternative unvibrated jet, or Hertz technology, has been the basis of the Applicon product range. Applicon's three-colour plotter will print a 22-by-

(continued on next page)

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34in. sheet in seven minutes with a resolution of 125 points per inch. A rotating drum secures the substrate — a pre-coated diazo-based paper or plastic film — and the jets are moved by a controlled lead screw.

The Applicon system uses a nine-track magnetic-tape unit to transmit data to the printer, so it is a useful product for the mainframe user who wants to build up an image database on tape. Using the subtractive primary colours cyan, magenta and yellow, the system can produce over 4,000 colour shades.

Although relatively slow, this type of equipment has the advantage of producing large pictures to a resolution acceptable for cartography and processing aerial and satellite images.

Transducer pump

The impulse, or drop-on-demand printer, will jet ink only when the computer instructs it to do so. Ink is supplied at a low pressure so that the natural resistance of surface tension will normally prevent the flow. A ceramic transducer in the print head is given an electrical charge to provide a pumping action. Piezo-electric technology reduces the size of the equipment and makes it cheaper to manufacture.

There have been problems such as the formulation and manufacture of suitable

inks which dry on the page rather than in the nozzle. This is why most impulse jets are suitable only for printing on paper, and not on other surfaces.

Several companies are using the process for alphanumeric printing. Silonics' Quietype character printer has seven nozzles and prints 210 characters per second. Siemens makes the PT 80 serial printer which has a 12-by-nine matrix and prints at speeds up to 270 characters per second.

PrintaColor has made a big investment in impulse ink jets and believes it can challenge the Applicon dominance in colour plotting. It launched the IS-8001 and GP-1024 desk-top units earlier this year. The standard unit will print a page-sized image in two minutes with a resolution of 90 dots per inch.

Raymond Keithley of PrintaColor is optimistic: "Drop-on-demand ink-jet technology is broadening the range of applications and lowering the cost of colour documentation, making colour graphics more appealing to the small businessman and manufacturer".

Competition in this branch of computer graphics is fierce. New companies such as Advanced Color Technology of Chelmsford, Massachusetts are challenging the market leaders. ACT is making its debut with the typewriter-sized ACT-1 colour copier. This can produce a full-colour page in 90 seconds with resolution

of 85 dots per inch vertically and 140 horizontally.

Cambridge Consultants has developed a technique of precision micro-encapsulation — enclosing one droplet of ink inside another. This compound jet could have applications outside the field of printing, perhaps in medical use or in other areas of manufacturing. Mike Keeling, who is in charge of the printing system group at CCL, is sceptical, however, about the ability of ink-jet technology to challenge conventional methods of top-quality printing. He says: "It is unlikely that anything approaching litho or gravure quality will appear at a competitive price within the next five years".

Competing technologies

In the office, ink jet will have to compete with laser xerography. Although ink has the advantage of needing no subsequent processing, laser techniques will be more appropriate for high-volume work.

The benefits of using non-impact systems for printing on rough surfaces are clear. Standard ink-jet products for printing wallpapers and fabrics will soon appear. Ink jet will also become popular in manufacturing industries, reducing the cost of printing instructions, names and logos on a variety of products. There is no shortage of applications. In many cases, ink jet is a practical necessity, not just an alternative or a luxury.

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How structured is BBC Basic?

Structures encourage economic programming. John Gordon and Tony Shaw show how to build a library of subroutines using BBC Basic.

OVER THE PAST few years there has been a definite move towards structured programming. There has also been criticism of poorly structured languages such as the primitive Basics of the early micros.

Most of the newer dialects of Basic have introduced structured concepts that go some way towards refuting this criticism. Microsoft Basic 5.1 introduced the While-Wend construct. The Acorn Atom introduced the Do-Until and both had If-Then-Else. Other languages such as Comal and the SuperPet Waterloo Basic have attempted to introduce similar structures to those of Pascal. Roy Atherton gave a detailed discussion of these structures in the June 1981 issue of *Practical Computing*.

The BBC Micro is an inexpensive tool for introducing the techniques associated with structured programming. There are some limitations to the BBC Basic procedures such as its lack of the ability to pass arrays, found in Comal. On the other hand, as well as a structured Basic there is high-resolution colour graphics, an assembler, analogue-to-digital converters and very good debugging features.

A fundamental aid to good programming practice is the ability to use long and meaningful variable names. BBC Basic allows variable names such as Gross Pay, Remainder and Totals for Month. Variable names in BBC Basic can be of unlimited length, and embedded key words are allowed. The only restriction is that variable names must not begin with a Basic keyword.

BBC Basic also includes For-Next, as in traditional Basic, and Repeat-Until, which is similar to the Do-Until of Atom Basic but is more standard. The BBC Basic If-Then-Else construct has only a single line whereas in Comal or Waterloo Basic it is possible to have an If construct spread over many lines. However, by allowing up to 240 characters in a Basic line, fairly extensive If statements may be used.

Criticism justified

BBC Basic does not implement a While-Endwhile construct although the published technical specifications indicate that it was planned. There is also no Case structure, and if a multi-way decision is required On-Gosub must be used. The omission of these two features leaves the BBC Basic open to some criticism, but BBC Basic is entitled to call itself a structured language by virtue of the range of features that it implements.

An additional desirable feature in a structured language is for the programmer to be able to write large programs in the form of a series of smaller procedures, the corner-stones of programming. These procedures can later be combined to form the full program. If the procedures are recorded separately in a library then the language can be effectively extended. These features are present in BBC Basic, and a library of procedures can be built using the cassette-tape storage.

The procedures available in BBC Basic, although not quite of the standard of Comal or Pascal, are well designed and

easy to use. For example, to call the procedure shown in listing 4 you simply state its name following the Proc statement. For example,

100 PROCprocedure name
calls the procedure Procedure Name which is defined in listing 4. It is equivalent to a Gosub in traditional Basic, except that the subroutine name can be meaningful rather than just a line number.

BBC Basic variables can be declared as local to the procedure. In listing 5, Index takes the values 1 to 10 within the procedure PROCjimmy, but maintains its value of 100 in the main part of the program. Values can be passed to parameters that are used within subroutines where such parameters will be local to the procedure. This is accomplished by

(continued on next page)

Listing 5.

```
>LIST
10 Index=100
20 PROCjimmy
30 PRINT "Index= "Index
40 END
100 DEF PROCjimmy
110 LOCAL Index
120 FOR Index = 1 TO 10
130 PRINT "How's it gawin Jimmy!!!"
140 NEXT Index
150 ENDPROC

>RUN
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
How's it gawin Jimmy!!!
Index= 100
```

Listing 1.

```
>LIST
100 FOR I=1 TO 10
110 PRINT I,I*I
120 NEXT I
130 END

>RUN
1      1
2      4
3      9
4     16
5     25
6     36
7     49
8     64
9     81
10    100
```

Listing 4.

```
>LIST
1000 DEF PROCprocedure_name:REM all procedure names begin with PROC
1010 REM This procedure only prints a message, normally procedures
    would be more useful
1020 PRINT "This is a silly procedure"
1030 ENDPROC:REM procedure declarations end with ENDPROC
```

Listing 3.

```
>LIST
100 REM This program exhibits the IF..
    THEN..ELSE construct
110 REPEAT
120 INPUT A
130 IF A<10 THEN PRINT "A(10)"
    ELSE IF A<20 THEN PRINT "A(10), <20"
        ELSE PRINT "A(20)"
140 UNTIL A=100
150 END

>RUN
?3
A(10
?13
A(10), <20
?24
A(20
?100
A(20
```

Listing 2.

```
LIST
100 REM This program shows the
    REPEAT...UNTIL construct
110 Ith=0:Last=10
120 REPEAT
130 Ith=Ith+1
140 PRINT "This is the ",
    Ith"th time around
150 UNTIL Ith=Last
160 END

RUN
This is the 1th time around
This is the 2th time around
This is the 3th time around
This is the 4th time around
This is the 5th time around
This is the 6th time around
This is the 7th time around
This is the 8th time around
This is the 9th time around
This is the 10th time around
```


(continued from previous page)

incorporating a parameter list in the procedure declaration

DEF PROCName (parameter 1,
parameter 2, ...)

and a set of values in the procedure call
PROCName (value 1, value 2, ...)

where value 1, 2 ... can be literal values, or variables which have values already assigned to them.

In listing 6, the values of the parameters First, Second and Third are assigned when the procedure is called, and if these parameters are equivalent to some variables in the main program then the values in the main program are unaffected.

The only variables in the main program that will be affected by the action of the procedure are those such as Result, that is the Global variables. Any variable not declared as Local or not declared in the procedure heading is Global.

Recursive elegance

An additional feature of procedures in BBC Basic is that they may call themselves recursively. Recursion can be an elegant and concise method of expressing the logic of a program and is much used in mathematical programming. It should however be used with caution. BBC Basic

also implements user-defined multi-line functions, which can also be recursive, as in listing 8.

It would be useful to have the ability to build a library of procedures, functions or subroutines which could be loaded from tape to form a single program. As supplied, the BBC Micro can only use a tape for program storage. When a program is loaded from tape it replaces any other program code in memory, at location 0E00 onwards. Thus, although procedures or subroutines can be written and then saved on tape, there is no command designed to successively load them into program memory to form a single program.

The technique in table 1 will overcome this problem as it allows a series of procedures or subroutines held on tape to be loaded into a continuous area of program memory. To use this technique the programmer must ensure that the line numbers of all stored procedures or subroutines are in a distinct high range, for example 10000 onwards, with the main program line numbers in a low range such as 0 to 9000. Using this technique a library of procedures, subroutines and functions can be built up and later linked together, as required.

Table 1. Loading procedures from tape to main program.

Action	Example
Type in or load the main program in the normal way	
Decrease Lomem by 2.	>LOMEM=LOMEM-2
Examine the value of Lomem in hex.	>PRINT~LOMEM
Once this new value of Lomem is known the location in memory into which the procedure is to be loaded can be supplied; xxxx is the hex value of Lomem.	> *LOAD "PROC" xxxx
The micro displays a message that includes the byte length zzzz of the program.	PROC1 yy zzzz
Increment the value of Lomem by the byte count value.	>LOMEM=LOMEM+&zzzz
List the program; this updates the value of Top.	>LIST
Renumber the entire program to ensure that there will be no line number conflict when the next procedure is loaded using the same technique.	>RENUMBER

Example.

```

>LIST
100 REM MAIN PROG
110 INPUT "Enter three numbers ";A,B,C
120 PROCminimum(A,B,C)
130 PRINT "minimum = ";Result
140 PROCsum(A,B,C)
150 PRINT "sum = ";Result
160 END

>LOMEM=LOMEM-2
>PRINT ~LOMEM
    E8A
>*LOAD "minimum" 0E8A

Searching
Loading
minimum 00 007B

>LOMEM=LOMEM+&7B
>LIST
100 REM MAIN PROG
110 INPUT "Enter three numbers ";A,B,C
120 PROCminimum(A,B,C)
130 PRINT "minimum = ";Result
140 PROCsum(A,B,C)
150 PRINT "sum = ";Result
160 END
10000 DEF PROCminimum(First,Second,Third)
10010 IF First<Second THEN Result=First
    ELSE Result=Second
10020 IF Third<Result THEN Result=Third
10030 ENDPROC
>RENUMBER
>LOMEM=LOMEM-2
>PRINT ~LOMEM
    F03
>*LOAD "sum" 0F03

Searching
Loading
sum 00 0042

>LOMEM=LOMEM+&0042
>LIST
10 REM MAIN PROG
20 INPUT "Enter three numbers ";A,B,C
30 PROCminimum(A,B,C)
40 PRINT "minimum = ";Result
50 PROCsum(A,B,C)
60 PRINT "sum = ";Result
70 END
80 DEF PROCminimum(First,Second,Third)
90 IF First<Second THEN Result=First
    ELSE Result=Second
100 IF Third<Result THEN Result=Third
110 ENDPROC
10000 DEF PROCsum(First,Second,Third)
10010 Result=First+Second+Third
10020 ENDPROC
>RENUMBER

```

Listing 6.

```

>LIST
100 REM Main program
110 INPUT "Enter three numbers",A,B,C
120 PROCminimum(A,B,C)
130 PRINT "Result= ";Result
140 END
1000 DEF PROCminimum(First,Second,Third)
1010 IF First<Second THEN Result=First
    ELSE Result=Second
1015
1020 IF Third<Result THEN Result=Third
1030 ENDP
>RUN
Enter three numbers?5,6,7
Result= 5

```

Listing 7.

```

100 REM Main program
105 Result=-999
106 PRINT "Result= ";Result
110 INPUT "Enter three numbers",A,B,C
120 PROCminimum(A,B,C)
130 PRINT "Result= ";Result
140 END
1000 DEF PROCminimum(First,Second,Third)
1010 IF First<Second THEN Result=First
    ELSE Result=Second
1015
1020 IF Third<Result THEN Result=Third
1030 ENDP
>RUN
Result= -999
Enter three numbers?1,2,3
Result= 1

```

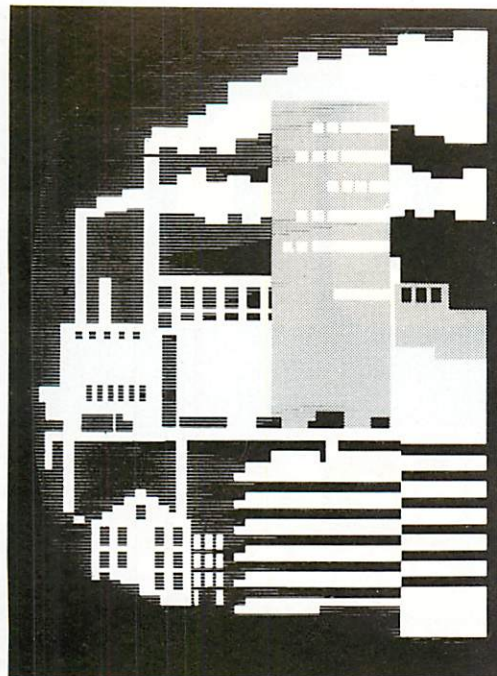
Notice in the above program the values of Result.

Listing 8.

```

5 REM This program uses recursion to evaluate N factorial
10 INPUT N
20 PRINT FNfactorial(N)
30 END
100 DEF FNfactorial(N)
110 LOCAL K
120 IF N=1 THEN K=1
    ELSE K=N*FNfactorial(N-1)
130 =K
>RUN
?5

```

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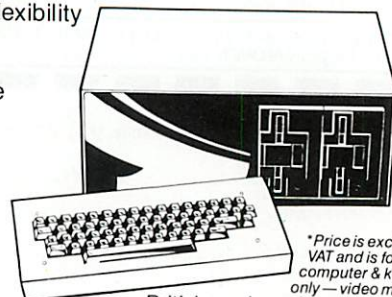
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Get down to the root of the problem

Conventional methods for finding the roots of a polynomial may prove difficult if the function is not well-behaved. Patrick Howden and Noel Kantaris present an original algorithm which does the same job, and is able to deal with closely spaced and complex roots.

TRADITIONAL METHODS for solving for roots of equations depend on being able to differentiate the function concerned. One fairly accurate iterative formula, which usually gives several decimal places of accuracy, is the following:

$$x_0 \approx a_{n+1} = a_n + \frac{F'(a_n)}{F''(a_n)} \times \left[-1 + \left\{ 1 - \frac{2F(a_n)F''(a_n)}{(F'(a_n))^2} \right\}^{\frac{1}{2}} \right]$$

where a_n is the guessed root, $F(a_n)$ is the function evaluated with a_n , and F' and F'' are the first and second differentials of the function.

Such a method requires the prior calculation of the various differential coefficients and is severely limited if either F' or F'' is zero, or if the function inside the curly brackets is negative so that its square root is complex. Furthermore, this precision formula does not have much capture range, which is also true of the series methods of calculating roots as a sum of terms. It would therefore be very useful to have a simpler method which can also deal with multiple roots, even those lying close together or of very large magnitude.

Our equation-solving method presented here has been engineered on empirical lines. It achieves great precision after only a few steps on a simple calculator. Any errors that might be introduced along the way are self-correcting, and the capture range from a trial solution — typically zero — is usually indefinitely large.

An equation which can be represented as a function of x and can be written as $F(x) = 0$ will have a root at x_0 and trial roots given as $a_0, a_1, \dots, a_n$. Near a root, x_0 can be approximated by

$$x_0 \approx a_n \pm Q[F(a_n)]$$

for some function Q of $F(a_n)$, provided a_n is sufficiently close to x_0 and Q approaches zero as $F(a_n)$ approaches zero, that is, as a_n approaches x_0 . In particular

$$x_0 \approx a_n \pm \frac{F(a_n)}{q}$$

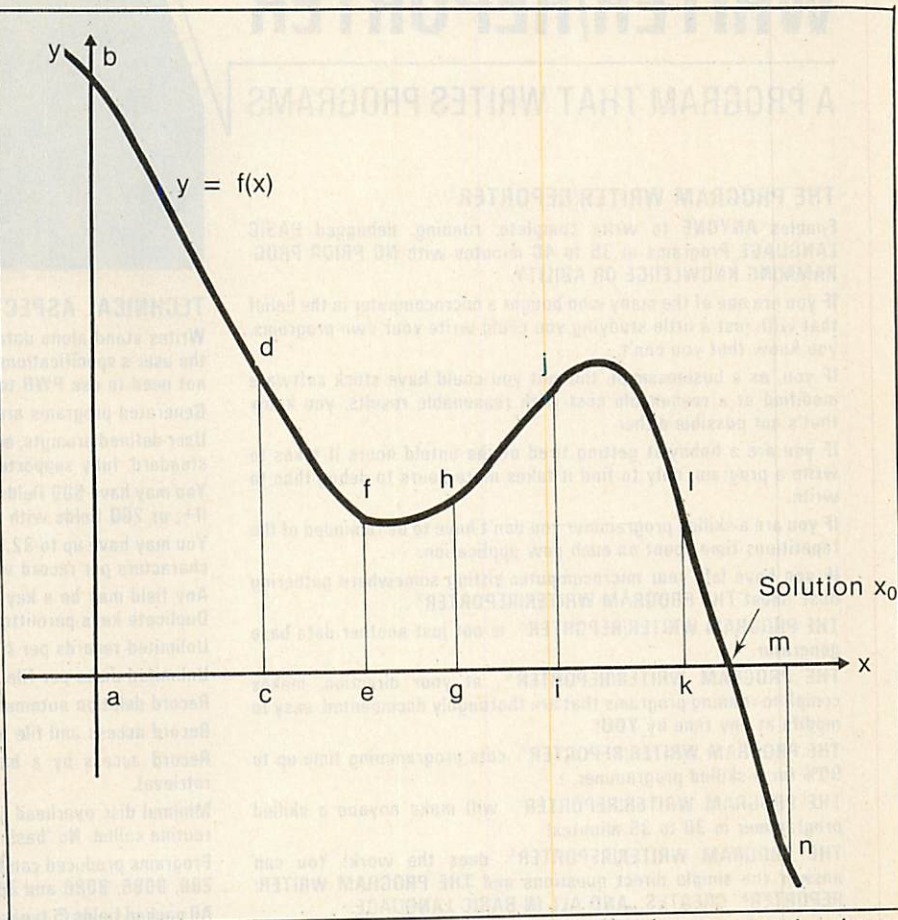


Figure 1. Schematic of $\sinh^{-1}$ function: $ac = \sinh^{-1}ab$, $ce + \sinh^{-1}cd$, etc; note sign change near the root which gives corresponding halving of increment.

where q is an appropriate variable number to be derived later.

If any a_n is substituted into $F(x)$, for example, $a_n = 0$, then $F(a_n)$ could be too impossibly large to iterate. Therefore, Q must act as a well-behaved attenuating function: the larger $F(a_n)$, the heavier the required attenuation. Further, the choice of Q must satisfy two more requirements:

$$Q[F(a_n)] = F(a_n)$$

for small $F(a_n)$, and

$$Q[-F(a_n)] = -Q[F(a_n)]$$

Thus, Q must be monotonic, more or less symmetrical, and must not saturate.

Two such functions were considered and tried. The first,

$$Q = \tan^{-1}[F(a_n)]$$

appeared to be a good choice until an attempt was made to evaluate equations with large answers, say $x_0 = 100$. Although the answer was reached eventually, it was rather too slow for comfort. A further disadvantage of this choice is that the $\tan^{-1}$ function has a limiting value of $\pm\pi/2$. A strong advantage, however, is that most reasonably simple calculators support this function.

To overcome the slowness of the $\tan^{-1}$ function, the inverse hyperbolic sine function $\sinh^{-1}$ was chosen as a function for Q . The expression

$$\sinh^{-1}[F(a_n)] = \ln[F(a_n) + \{F(a_n)^2 + 1\}^{\frac{1}{2}}]$$

must be used with those calculators without the $\sinh^{-1}$ function and in any computer programs.

Another valid form for Q could be

$$\frac{F(a_n)}{q}$$

where q is adjusted at each iteration in order to adapt to the conduct of computation — a sort of feed-forward adaptive gain technique. A potential diverging or conversely go-slow tendency, is counteracted by doubling or halving q before any iteration. q is a "gain control" or stability control — it stops oscillations.

To meet both criteria, the adapted function is tentatively shown as

$$x_0 \approx a_{n+1} = a_n \pm \frac{\sinh^{-1}[F(a_n)]}{2^r}$$

where r is a $\pm$ integer or zero, especially at the first step. It is better adapted to hand calculators.

(continued on page 127)

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(continued from page 125)

The algorithm, unlike the traditional Newton-Raphson method, tends to be more stable under varied conditions. Although there may be better shaping functions than $\sinh^{-1}$ — calculus of variations schemes would probably reveal them — at best, they could only save a few iteration steps in reaching any desired precision.

Programming is greatly simplified by the adoption of the algorithm

$$x_0 \approx a_{n+1} = a_n \pm 2 \left(\frac{p-r}{3} \right) \sinh^{-1} [F(a_n)]$$

where r is bumped up by one when the sign of $F(a_n)$ changes, and p is bumped up by one when the computation is going too slowly.

Gain control

The procedure for finding roots is related to electronic analogue-to-digital conversion, while the 2^r divisor is simply a crude averaging method which is simpler than, say, a parabolic or incremental straight-line fit. Thus, if

$$\pm \sinh^{-1} [F(a_{n+1})]$$

is opposite in sign to that of the previous $\pm \sinh^{-1} [F(a_n)]$

you increment r by one, that is you divide by a further power of 2 while maintaining p the same as before. When they have the same sign, increment p by one while maintaining r at its previous value. This develops the adaptive gain control.

Figure 1 illustrates how the algorithm operates. Newton-Raphson's method would oscillate on this curve unless the starting point were chosen very near the

Table 1. Solution of one root of seventh-degree trial polynomial.

Enter values for:

$X_{old} = 0$

($P = 0$ — set by the program)

$R = 0$

Sign = -1

(Maximum number of iterations = 100

— set by the program)

Decimal accuracy = .00001

Iter	P	R	Root
1	1	0	8.65148245
2	1	1	-1.32675618
3	1	2	0.77906635
4	2	2	3.49531867
5	2	3	1.52876973
6	2	4	2.16587852
7	2	5	1.83954148
8	2	6	1.96781340
9	2	7	1.90972184
10	2	8	1.93079275
11	2	9	1.92176434
12	2	10	1.92342333
13	2	11	1.92296889
14	3	11	1.92287386
15	3	12	1.92287964

To change parameters type RUN 50
To change function type RUN ROOTS

F(x)	Trial X_{old} R	S = sign op $\pm \sinh^{-1}$	Increment sign S_1	Max no. of iterations, N	Decimal accuracy P	Optional fine search mode. Increment L, which raises flags K
Equation to be solved	Often both zero. $P = 0$	Select to find nearest root	Initially +	Always 100	Typically .00001	

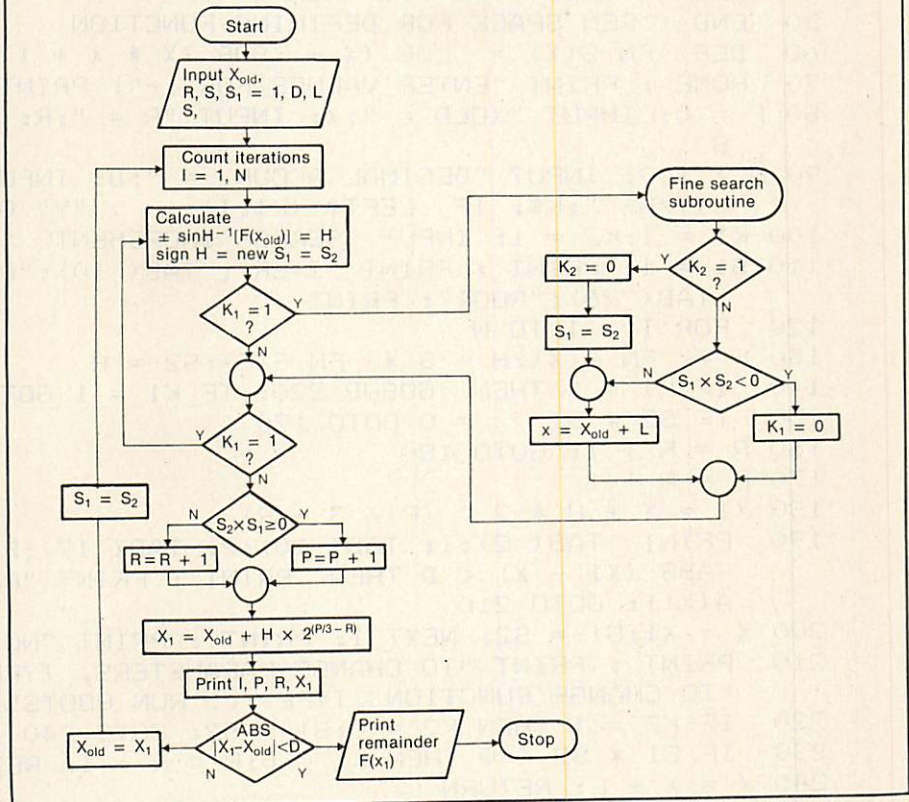


Figure 2. Flowchart for single roots, including a fine-search routine.

solution. The flowchart in figure 2, when applied to a polynomial, such as

$$F(x) = x^7 + 28x^4 - 480 = 0$$

adequately illustrates the roots solving technique. Initial conditions are set at $x = 0$, $p = 0$, $r = 0$. Sign S of the $\sinh^{-1}$ function is taken as negative. If it were chosen positive it would find other answers, not necessarily of any particular sign. The first S_1 , a sort of pre-initial sign, is always assumed positive.

The total number of iterations allowed is pegged at 100 in order to prove the absence of a root in that direction. A root is assumed to have been found if

$$\text{Abs } [F(a_{n+1}) - F(a_n)]$$

is less than a desired decimal accuracy, in this case 0.00001.

The first step is to calculate $F(0)$, which is -480 for the particular example. Then H is found from

$$H = -\sinh^{-1} [F(0)] = -\sinh^{-1} [-480] = +6.86699$$

The sign of H is stored in S_2 , to be compared with the previous sign S_1 . All that remains is obvious, yielding one solution at $x = 1.9228816$ after 15 iterations as shown in table 1.

Another solution will usually be found simply by reversing the sign S with the same initial x , and $r = 0$. However, there happen to be two negative solutions very close together, so that iterating negatively from $x = 0$ can skip both solutions

altogether, unless the iteration takes very small steps by setting r as large as 10, for example. Starting at $x = -2.6$ with S as negative gives a solution at $x = -2.57780046$.

Fine searching

To find these closely spaced roots a simple fine-search mode subroutine is included in the program. It hunts for a sign change in the value of $F(x)$, starting from x_{old} and stepping by a small increment L , which is an input parameter. When a sign change is encountered the program continues to evaluate precisely the approximately discovered root as before. In this way, with $r = 10$, $x = 0$, $L = -0.01$ and $S = +1$, the root at $x = -2.45808973$ is found. Starting from a slightly more negative value of x , namely -2.46 with $S = -1$ and the fine-search mode in operation, a third real root is evaluated at $x = -2.57780046$. All other roots are thus complex.

Figure 3 shows these solutions where, for instance, in order to compute the +1.92 solution, S will have to have a negative sign, with an initial x placed anywhere from the -2.45 solution to $+\infty$. Conversely, the -2.45 solution will be found with a positive S and with x lying between -2.57 and +1.92, and so on for the -2.57 solution.

(continued on next page)

Solution seeking is usually much easier than in this example, where the equation has two roots close together so that they must be approached with the fine-search mode. The same method can be applied, with much less difficulty, to a bridge-cable catenary problem. If the bridge consists of a 300m. heavy cable suspended between two horizontal points 260m. apart, you can find out by how much the cable sags by solving for x in the expression

$$F(x) = x \sinh \left(\frac{130}{x} \right) - 150 = 0$$

and substitute into

$$\text{sag} = x \cosh \left(\frac{130}{x} \right) - x$$

The initial conditions on the algorithm are $x_{old} = 100$, $r = 0$, $S = +1$, which gives the root as $x = 138.325993\text{m}$, which in turn gives the sag in the bridge cable as 65.7183163m.

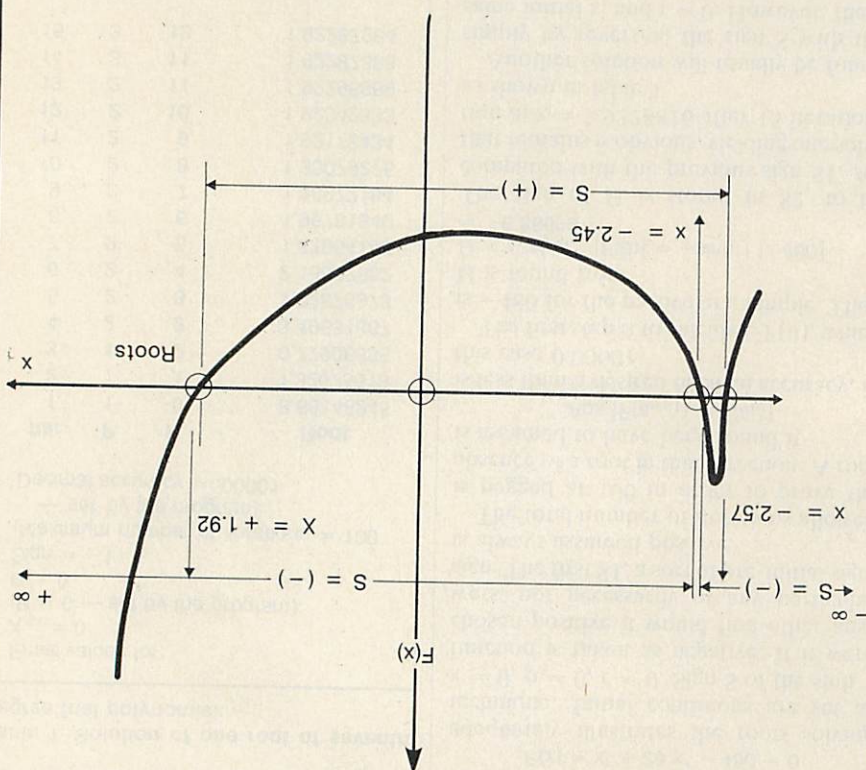
The Apple Basic program used to solve these examples is shown in listing 1. When the program is first run, it allows you to specify your function in line 50, which for the first example should be typed as follows:

$$50 \text{ DEF FNA}(X) = X \wedge 7 + 28 * X \wedge 4 - 480$$

To change the equation, simply retype line 50 with the new equation appearing after the = sign.

□

Figure 3. Regions in which trial root can start in order to capture a particular root.

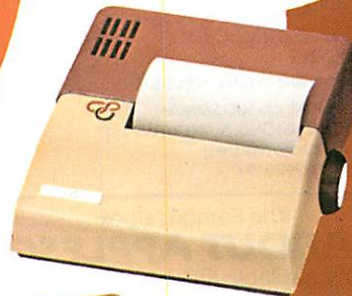
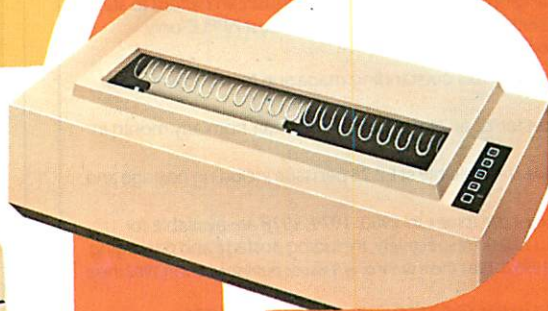


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10 REM ROOTS WITHOUT DIFFERENTIALS
20 HOME: PRINT "TYPE YOUR FUNCTION AS PER EXAMPLE": PRINT
30 PRINT: PRINT "50 DEF FNA(X)=X^2+3*X-10": PRINT: PRINT
40 PRINT "THEN TYPE ... RUN 50"
50 END: REM SPACE FOR DEFINING FUNCTION
60 DEF FN S(X) = LOG (X + SQR (X * X + 1))
70 HOME: PRINT "ENTER VALUES FOR :-": PRINT
80 P = 0: INPUT "XOLD = ": X: INPUT "R = ": R: INPUT "SIGN = ": S
90 N = 100: INPUT "DECIMAL ACCUR" = "D: INPUT "FINE SEARCH?
(Y/N) "K: IF LEFT$ (K$,1) < "Y" GOTO 110
100 K1 = 1: K2 = 1: INPUT "SEARCH INCREMENT? "I: L
110 S1 = 1: PRINT: PRINT "ITER": TAB (10); "P": TAB (17); "R":
TAB (28); "ROOT": PRINT
120 FOR I = 1 TO N
130 F = FN A(X): H = S * FN S(F): S2 = H
140 IF K1 = 1 THEN GOSUB 220: IF K1 = 1 GOTO 130
150 IF S2 * S1 > 0 GOTO 170
160 R = R + 1: GOTO 180
170 P = P + 1
180 X1 = X + H * 2 / (P / 3 - R)
190 PRINT TAB (2); I: TAB (10); F: TAB (17); R: TAB (25); X1: IF
ABS (X1 - X) < D THEN PRINT: PRINT "REMAINDER = "F: FN
A(X1): GOTO 210
200 X = X1: S1 = S2: NEXT I: PRINT: PRINT "NOT CONVERGING"
210 PRINT: PRINT "TO CHANGE PARAMETERS, TYPE ... RUN 50": PRINT
220 IF K2 = 1 THEN K2 = 0: S1 = S2: GOTO 240
230 IF S1 * S2 < 0 THEN K1 = 0: R = R - 1: RETURN
240 X = X + L: RETURN

```

Listing 1. Apple Basic implementation of solution algorithm.



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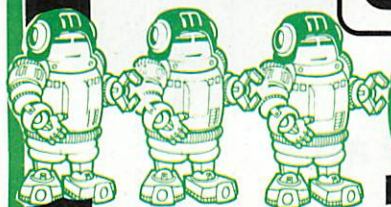
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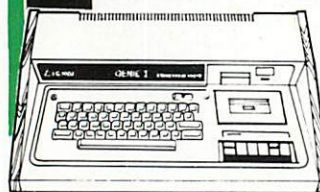
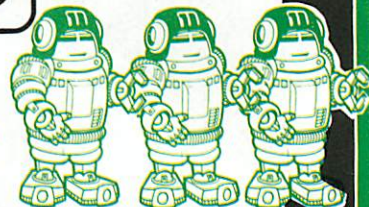
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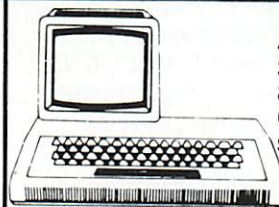
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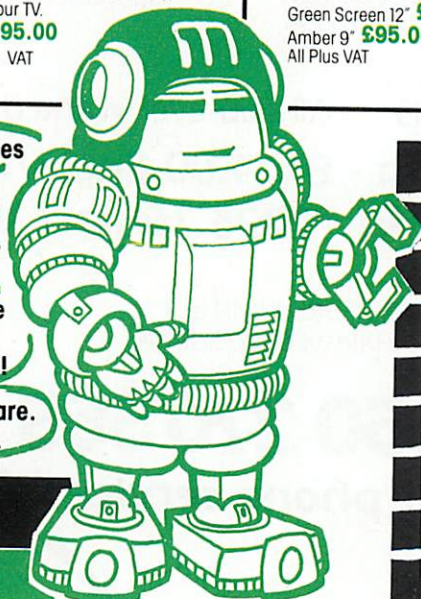
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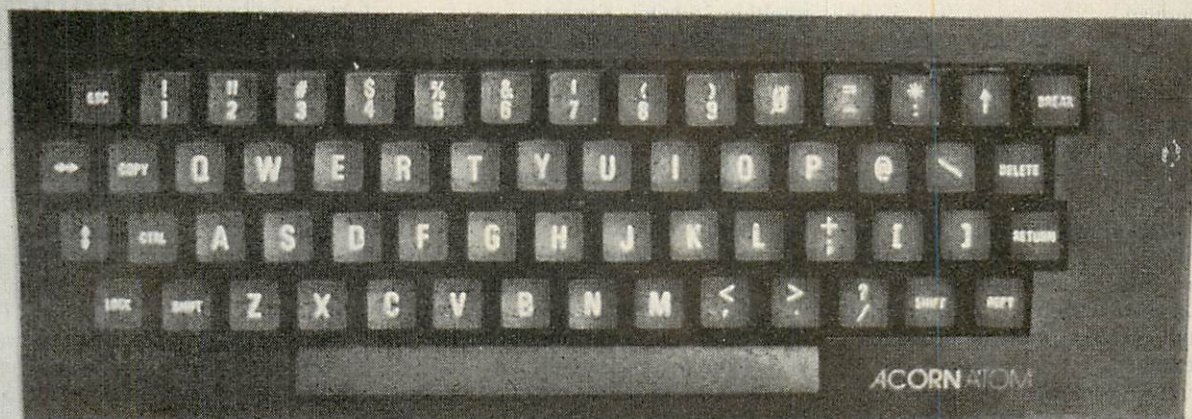
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Save memory space — dump your assembler



Norman Kirkby continues his series on 6502 assembler programming with a method of expanding your available memory by making sure that you only store essential information.

ASSEMBLER MNEMONICS use a large amount of memory, but you can save space by throwing them away after they have done their job of assembling the machine code. Suppose you are designing and entering a program at the keyboard, and as it grows you find the error message Not Enough Room. You have run out of memory.

There is a great deal you can do to make your program use memory more economically. You can use abbreviations such as P. for Print; put as many statements on a line as possible, saving two bytes for each unnecessary line number and one for each line terminator as well as one for each character; and remove all

unnecessary spaces. You can train yourself to write economically; for example,

Q = RND; IFQ = 50GOTO ...
uses four more bytes than

IFRND = 50GOTO ...

If your program contains a significant number of assembler mnemonics a vastly greater saving can be made if you can find a way to dispose of them after they have done their job of assembling the machine code. On average, one byte of machine code requires at least three bytes of assembler mnemonic. A program consisting of 4,500 bytes of text — of which one-third is assembler with resulting machine code of 500 bytes — contains a total of 5,000 bytes. It could be reduced by at least 1,500 bytes by disposing of the assembler after use.

What is needed, therefore, is a section of memory that is not normally available for program text, or that is not needed until your program is actually running, where you can temporarily park the assembler part. An obvious choice is the Atom's graphics area which starts at

memory location #8200, and will provide 0.5K if you have graphics mode 1, 1K with mode 2, 2.5K with mode 3 and 5.5K with mode 4. Remember that even if your program involves graphics, the graphics memory can still be used temporarily for the assembler part.

To make use of this strategy you must first split your original Basic program into two parts or, if you are writing a new program, write it in two parts. The first will contain only Basic, and the second all the assembler mnemonics and only that Basic needed to make them work.

Enter the Basic part in the normal way, that is at location #2900, or at #8200 on the unexpanded Atom. Enter the assembler part into the temporary memory park, and run it so that it assembles the machine code at the end of the Basic part. The assembler part is now redundant, so amend the Basic part slightly to make it independent of the assembler part. Finally, run the Basic part and save it

(continued on next page)

```
10 REM ORIGPROG
20 DIM S(10),AA(5),LL(4)
25 DIM P(-1)
30 [
40:LL0 LDA @65
50:LL1 JSR #FFF4
60 CLC;ADC @1
70 CMP @73;BNE LL1
80 LDA @32;JSR #FFF4
90 RTS
```

```
100:LL2 LDA @72
110:LL3 JSR #FFF4
120 SEC;SBC @1
130 CMP @64;BNE LL3
140 RTS
150]
160 AA(5)=7
170 LINK LL0
180 LINK LL2
190 END
```


(continued from previous page)

with the machine code but without the assembler part, using the *Save routine.

The details of this procedure are much easier to implement than to describe. The OrigProg program, although short and trivial, illustrates the points well enough: it will print letters A to H, a space, and the letters H and A. If you have entered it, execute New to clear it out of the way.

OrigProg is then split into two parts — BasicProg and AssemProg. BasicProg contains only Basic statements, and AssemProg contains all the assembler mnemonics and only that Basic needed to make them work. The line numbers are the same in this example, but they need not be. AssemProg contains the Dim statement for the array LL, but no other arrays or strings from OrigProg, because LL is an array used only for the assembler mnemonics. The End statement is duplicated, of course.

Now enter BasicProg in the usual way, at memory location #2900, for example, and execute

PRINT & TOP

You will find in hexadecimal the first free byte after the program text. Write this down; if you have entered BasicProg exactly as shown you will get #2954. Now execute

?18 = #82

and then execute

NEW

which will switch to the upper text space.

If that memory area is not convenient for any reason, switch to, say, #8400, or #9000, or wherever else is suitable. Now enter AssemProg, leaving the number in line 25 blank for the moment. Add up the total of bytes reserved by the Dim statements in BasicProg, one for each string element that is part of a Dim statement, four for each array element that is part of a Dim statement, and five for each array element part of an FDim statement. An ordinary array element within a Dim statement is a word, and is therefore four bytes long.

Remember to count the zeroth ele-

```
10 REM ASSEMPROG
20 DIM LL(4)
25 P=#2979
30 C
40:LL0 LDA @65
50:LL1 JSR #FFFF4
60 CLC:ADC @1
70 CMP @73:BNE LL1
80 LDA @32:JSR #FFFF4
90 RTS
100:LL2 LDA @72
110:LL3 JSR #FFFF4
120 SEC:SBC @1
130 CMP @64:BNE LL3
140 RTS
150 J
190 END
```

```
10 REM BASICPROG
20 DIM S(10),AA(5)
160 AA(5)=7
170 LINK LL 0
180 LINK LL 2
note the two extra spaces
190 END
```

ment. For BasicProg the result is 11×1 for string S, and 6×4 for array AA, totalling 35 bytes. Execute

PRINT & (#2954 + 35 + 2)

The result is #2979 — the extra 2 is to provide a safety margin — which is the address in hex of the memory location closest to the end of the text of BasicProg, plus its reserved string and array space, at which it is safe to assemble the first machine code.

If it were assembled at a closer location it would be overwritten by assignments of values to the string and array elements. If it were very close, it would overwrite the end of the text of BasicProg.

Line 25 of OrigProg contains the usual Dim P (-1) statement which instructs the Atom to assemble the machine code with the first code at memory location Top plus the memory locations reserved for strings and arrays by previous Dim statements in the current program — OrigProg, in this case. That is fine for an integral Basic-plus-assembler program such as OrigProg, but with AssemProg the machine code needs to be assembled starting at the safest location closest to BasicProg, not at the safest memory location closest to AssemProg itself.

The number #2979 is the address of that memory location, and line 25 of AssemProg instructs the computer to assemble the machine code, starting at location #2979.

Run AssemProg and confirm from the assembly listing that the first memory location is indeed #2979. Write down the address of the last memory location in the assembly listing: it is #2997 and is called the End address. You will need it later when saving. Now execute

?18 = 29

END

to switch back to the test space containing BasicProg and reset Top to that program.

After listing BasicProg you come to the step that makes BasicProg finally independent of AssemProg. Line 170 refers to an array element, and the line instructs the Atom to find out the value assigned to that element, treat it as a memory address, and execute the machine-code program that starts there. These LL-type array elements are creatures of AssemProg, and the values assigned to them by AssemProg disappear with it. The address to which line 170 points, is found by executing

PRINT & LLO

Replace LL 0 in line 170 with that address — it is #2979, of course — and do the same for line 180 and to any other assembler arrays that appear in your

real-life equivalent of BasicProg. There is no need to alter any of the references to array elements that appear only in AssemProg. They are used internally in that program to produce actual addresses in the machine code. Lines 170 and 180 now read

```
170 LINK #2979
180 LINK #298B
```

They originally had two extra spaces each because the statement Link LL0 — that is, without the extra spaces — occupies eight bytes of program text, whereas Link #2979 occupies 10 bytes. Without those extra spaces, putting in the hex number would have lengthened the text of BasicProg, resulting in any assignments to the array elements overwriting the beginning of the machine code.

AssemProg is now redundant, and you can run BasicProg to confirm that it prints out as for OrigProg. To save BasicProg and its machine code you need the End address #2997 which you established earlier. Add 1 to it, and execute

★ SAVE "BASICPROG" 2900 2998

This procedure saves all the contents of memory locations #2900 to #2997. It includes all the text of BasicProg and its machine code.

Now for the acid test. Switch the computer off and on to lose all memory contents. Load BasicProg in the usual way by executing

LOAD "BASICPROG"

and then run it: out comes the familiar printout without any assembler mnemonics being used.

If your real-life equivalent of AssemProg contains forward references you will need to put the assembler mnemonics and line 25 into a For-Next loop or use two Gosubs. If you have no RAM in the lower text space you could enter your real-life equivalent of BasicProg at #8200 as usual, and your AssemProg at, say, #8300.

In Atom assembler it is possible to refer to Basic variables in two ways. For example, LDA @D means "load the accumulator with the value of the Basic variable D". That works in AssemProg if D has previously been assigned its correct value in BasicProg — one which is no greater than #FF. Without the @ — for example, LDA D — a string must be dimensioned with one element, at least using DIM D(0). LDA D means "load the accumulator with the contents of memory location ?D".

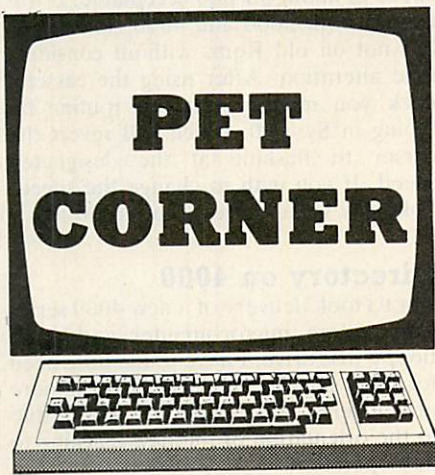
That is obviously a BasicProg variable and so the Dim statement must be part of BasicProg. If, after assembling the machine code, you alter BasicProg such that the length of its text is changed by even one byte either way, the address ?D will also change. So the address in the machine code that refers to ?D, although unchanged, will no longer be correct, and garbage or a crash will be the result. Avoid LDA K or ADC G or similar forms when using this technique. □

Open File

This regular section of *Practical Computing* appears in the magazine each month, incorporating Tandy Forum, Apple Pie, ZX-80/81 Line-up and the other software interchange pages.

Open File is the part of the magazine written by you, the readers. All aspects of microcomputing are covered, from games to serious business and technical software, and we welcome contributions on CP/M, BBC Basic, Microsoft Basic, Apple Pascal and so on, as well as the established categories.

Each month the best contribution will be awarded £20; others receive £6. Send contributions to: Open File, *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.



Typewriter

THIS SHORT PROGRAM by Andy Scott of Chapel-en-le-Frith, Cheshire, has been chosen as this month's best contribution

Pet Corner: Typewriter, a mini-word processor; Cursor flashing-speed control; Directory list routine for 4000 series; Maze game **135**

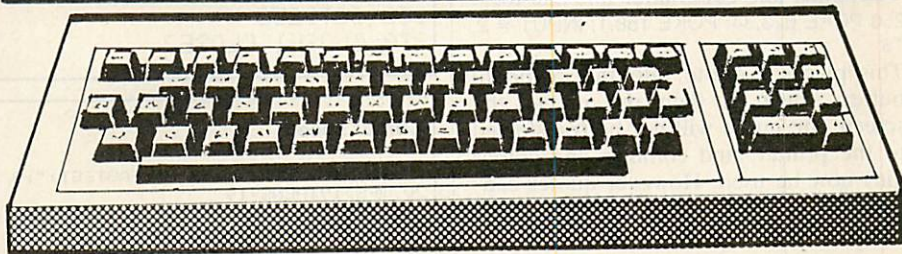
Tandy Forum: Moon Lander game; User-definable graphics; Tape name finder; Data-separator routine; Unknown tape loader **141**

Apple Pie: Galaxy Invaders; File parameter finder; Text file list **148**

Z-80 Zodiac: Sharp printer routine; Upgrading to Z-80B; Backgammon on Nascom **151**

6502 Special: Atom EPROM programmer **152**

ZX-80/81 Line-up: Volume of solid figures; Hunt game; 10-pin bowling; Obstacle game; Variable list machine-code routine; Superzap game; Circle-drawing program; Programming tips; Data-handling commands in Basic **157**



Guidelines for contributors

Programs should be accompanied by documentation which explains to other readers what your program does and, if possible, how it does it. It helps if documentation is typed or printed with double-line spacing — cramped or handwritten material is liable to delay and error.

Program listings should, if at all possible, be printed out. Use a new ribbon in your

printer, please, so that we can print directly from a photograph of the listing and avoid typesetting errors. If all you can provide is a typed or handwritten listing, please make it clear and unambiguous; graphics characters, in particular, should be explained.

We can accept material for the Pet, Vic and Sharp MZ-80K on cassette, and material for the larger machines can be sent on IBM-format 8in. floppy discs.

to Open File. It should prove useful if you occasionally write short messages or reports but cannot run to a full-blown word-processing package.

The program allows you to write text from keyboard on to the screen, with up to 79 characters on each line, while retaining the use of screen Edit keys. When you are satisfied that the line is correct, pressing the Return key copies the line on to the printer. Unshifted keys are lower case and shifted keys upper case, as on a typewriter.

There are a few basic rules to observe when using the program since the line is inputted from keyboard as a string:

- Leading blanks are disregarded, so for the first leading blanks use shift-spacebar. This creates ASCII character 96 instead of ASCII 32, the normal space used. It is the latter which the Pet Basic removes if they are leading.
- Do not start a line with a ". If you require a

leading quote, type shift-spacebar, and then the".

- Do not make the last character in a line a quote: follow it by shift-spacebar.
- When inputting data the Pet Basic reads up to commas and colons, then comes up with the message Extra ignored. To get round this the program uses [and] — the top, right-hand keys on the main alphanumeric block — to replace the comma and colon respectively. When you press Return at the end of a line, the program prints out the appropriate commas and colons.
- No more than 79 characters may be used on each line.
- For a space between lines just press Return.
- When you have finished typing, enter *Return on a new line.
- Provision is made for automatic paging of the paper in the printer.

The main features of the program are as follows:

Line 180 zeros the line count, and is used for paging.

(continued on next page)

(continued from previous page)

Line 190 opens the keyboard: logical file number 2.

Lines 200-220 prompt for setting up the printer. Location 151 shows which key is being depressed; if the contents are 255, then no key is being pressed.

Line 230 clears the keyboard buffer count.

Line 240 gives lower-case display on screen, clears screen and opens printer.

Line 250 inputs line from keyboard.

Line 260 prints carriage return.

Line 270 checks if contents of line are *, then close files and end.

Line 280 looks for null string, that is user has only pressed Return.

Lines 290-320 redefine the string, inserting commas and colons if appropriate.

Lines 330-340 replace the line on the screen with corrected line as obtained in 290-320. They also cater for whether line is shorter than 40 characters, between 40 and 79 characters, or no characters. The line is then printed.

Line 350 gives automatic paging on to the next page.

Line 360 receives another line.

Line 370 closes current files and end.

If you would prefer not to use [and] for comma and colon alter line 250 to:

250 POKE 623,34: POKE 158,1: INPUT # 2, TS

This places a quote into the keyboard buffer, which is then put on to the screen. The quote will not be transferred to the printer, and commas and colons may now be used. However quotes cannot now be used within the text — the choice is yours.

Cursor speed

I FIND the Pet's flashing cursor irritating and I would much rather have a steady cursor like some other machines, complains Ian Payton of Winnersh, Berkshire. I have tried numerous machine-code routines without success. An alternative is to have a cursor flashing at a higher speed than usual.

Typewriter.

```
100 REM** TYPEWRITER BY ANDY SCOTT
120 REM* TYPE * TO ESCAPE
130 REM* DO NOT LEAD WITH QUOTE "
140 REM* [ USED FOR COMMA,
150 REM* ] USED FOR COLON:
160 REM* TO INSET PARAGRAPH USE SHIFTED SPACEBAR
170 REM*TYPE ONE LINE A TIME TO 79 CHARS
180 PA=0
190 OPEN2,0
200 PRINT"YOU MUST HAVE PUT PAPER AT THE TOP OF A PAGE"
210 PRINT"    PRESS ANY KEY IF READY"
220 IFPEEK(151)=255THEN220
230 POKE158,0
240 POKE59468,14:PRINT"J":OPEN1,4
250 INPUT#2,T$
260 PRINTCHR$(13)
270 IFT$="*"THEN370
280 L=LEN(T$):IFL=0THEN340
290 FORI=1TOL:P=ASC(MID$(T$,I,1))
300 IFP=91THENT$=LEFT$(T$,I-1)+CHR$(44)+MID$(T$,I+1)
310 IFP=93THENT$=LEFT$(T$,I-1)+CHR$(58)+MID$(T$,I+1)
320 NEXT
330 IFLEN(T$)>39THENPRINT"J"
340 PRINT"J":T$:PRINT#1,"J":T$:IFLEN(T$)=40THENPRINT"J"
350 PA=PA+1:IFPA=63THENPA=0:FORI=1TO3:PRINT#1:NEXT
360 GOTO250
370 CLOSE1:CLOSE2
```

Cursor speed.

```
10 INPUT"SPEED (1-19 1=FASTEST)";S
20 IFS>19THENS=19
30 DATA 169,143,141,144,0,169,3,141,145,0,96,165,168,201,20,208,5,169,999
40 DATA 141,168,0,76,888,777
50 INPUT"4000 OR 3000 SERIES ";ND$
60 IFND$="4000"THENA1=85:A2=228
70 IFND$="3000"THENA1=46:A2=230
75 IFND$<>"4000"ANDND$<>"3000"THEN50
80 FORLL=900TO924
90 READPD
100 IFPD=999THENPD=S
110 IFPD=888THENPD=A1
120 IFPD=777THENPD=A2
130 POKELL,PD
140 NEXTLL
150 SYS900
```

Directory machine-code routine. Listing 1.

LINE#	LOC	CODE	LINE
0001	0000		:AUTO LOAD. AFTER LISTING
0002	0000		:DIRECTORY PLACE CURSOR
0003	0000		:OVER DISIRED PROGRAM AND
0004	0000		:PRESS RETURN
0005	0000		:*****
0006	0000		:
0007	0000		:
0008	0000		CHRGOT = \$70
0009	0000		CHRGOT = \$76
0010	0000		* = \$0700
0011	0700	E6 77	START INC \$77
0012	0702	D0 02	BNE L88
0013	0704	E6 78	INC \$78
0014	0706	86 B3	L88 STX \$B3
0015	0708	BA	TSX
0016	0709	BD 01 01	LDA \$0101,X
0017	070C	C9 0F	CMP #\$0F
0018	070E	D0 14	BNE L33
0019	0710	BD 02 01	LDA \$0102,X
0020	0713	C9 B4	CMP #\$B4
0021	0715	D0 0D	BNE L33
0022	0717	A5 77	LDA \$77
0023	0719	D0 06	BNE L34
0024	071B	A5 78	LDA \$78
0025	071D	C9 02	CMP #\$02

(listing continued on page 139)

This routine produces a cursor flashing at any speed up to the normal speed. A speed of about 8 I find acceptable. It will run on both 3000 and 4000 series Pets, but not on old Roms without considerable alteration. After using the cassette deck you must restart the routine by typing in Sys 900, which will revert the cursor to flashing at the designated speed. If you wish to change the speed, Poke any value up to 19 into 0396 hex.

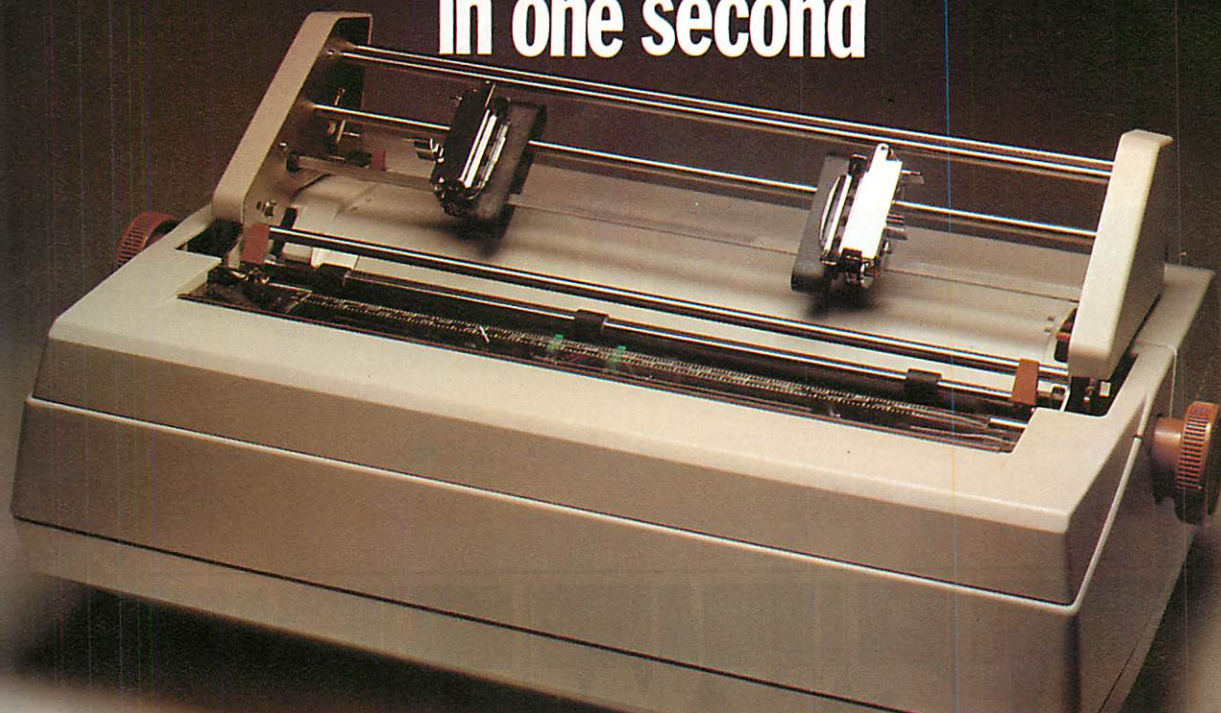
Directory on 4000

SINCE I took delivery of a new 4000 series Commodore microcomputer and 4040 floppy-disc drive, I have found little need for DOS support, writes H V Blackmore of Bridgend, Mid Glamorgan. This is due to the orientation of the new machine to disc operation.

One of the facilities I did not miss was the directory listing command >\$, so I set about writing a machine-code program which not only lists the directory, but also

(continued on page 139)

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PRACTICAL COMPUTING June 1982

(listing continued from page 136)

```

0026 071F F0 08      BEQ L35
0027 0721 4C 76 00    L34 JMP CHRGET
0028 0724 A6 B3        L33 LDX #B3
0029 0726 4C 76 00    JMP CHRGET
0030 0729 A0 FF        L35 LDY #FF
0031 072B C8          GET INY
0032 072C B1 77        LDA (#77).Y
0033 072E C9 3E        CMP #3E
0034 0730 D0 02        BNE L46
0035 0732 F0 68        BEQ DIR
0036 0734 C9 20        L46 CMP #20
0037 0736 F0 F3        BEQ GET
0038 0738 C9 30        CMP #30
0039 073A C0 E5        BMI L34
0040 073C C9 3A        CMP #3A
0041 073E 10 E1        BPL L34
0042 0740 C8          TEST INY
0043 0741 B1 77        LDA (#77).Y
0044 0743 C9 20        CMP #20
0045 0745 F0 F9        BEQ TEST
0046 0747 C9 22        CMP #22
0047 0749 F0 0A        BEQ LOAD
0048 074B C9 30        CMP #30
0049 074D C0 D2        BMI L34
0050 074F C9 3A        CMP #3A
0051 0751 10 CE        BPL L34
0052 0753 C0 EB        BMI TEST
0053 0755 A9 53        LDA #53
0054 0757 B5 DA        STA #DA
0055 0759 A9 03        LDA #03
0056 075B B5 DB        STA #DB
0057 075D 20 42 E0      JSR #E042
0058 0760 AD 3B 03      LDA #033B
0059 0763 C9 01        CMP #01
0060 0765 D0 04        BNE L101
0061 0767 A9 31        LDA #31
0062 0769 D0 02        BNE L102
0063 076B A9 30        LDA #30
0064 076D BD 53 03      STA #0353
0065 0770 A9 3A        LDA #3A
0066 0772 BD 54 03      STA #0354
0067 0775 A2 02        LDX #02
0068 0777 A0 07        LDY #07
0069 0779 B1 77        NAME LDA (#77).Y
0070 077B 9D 53 03      STA #0353.X
0071 077E F0 19        BEQ L43
0072 0780 C8          INY
0073 0781 E8          INX
0074 0782 C9 22        CMP #22
0075 0784 D0 F3        BNE NAME
0076 0786 CA          DEX
0077 0787 B6 D1        STX #D1
0078 0789 A9 08        LDA #08
0079 078B B5 D4        STA #D4
0080 078D A9 00        LDA #0
0081 078F B5 96        STA #96
0082 0791 B5 9D        STA #9D
0083 0793 20 08 F4      JSR #F408
0084 0796 4C FF B3      JMP #B3FF
0085 0799 4C 00 BF      L43 JMP #BF00
0086 079C A9 08        DIR LDA #08
0087 079E B5 D4        STA #D4
0088 07A0 E6 77        INC #77
0089 07A2 D0 02        BNE L100
0090 07A4 E6 78        INC #78
0091 07A6 B1 77        L100 LDA (#77).Y
0092 07A8 C9 31        CMP #31
0093 07AA D0 0C        BNE L23
0094 07AC A9 01        LDA #1
0095 07AE BD 3B 03      STA #033B
0096 07B1 A9 00        LDA #0
0097 07B3 BD 3C 03      STA #033C
0098 07B6 F0 20        BEQ D1RL
0099 07B8 C9 30        L23 CMP #30
0100 07BA D0 0C        BNE L27
0101 07BC A9 01        LDA #1
0102 07BE BD 3C 03      STA #033C
0103 07C1 A9 00        LDA #0
0104 07C3 BD 3B 03      STA #033B
0105 07C6 F0 10        BEQ D1RL
0106 07C8 C9 00        L27 CMP #00
0107 07CA D0 CD        BNE L43
0108 07CC A9 01        LDA #01
0109 07CE BD 3B 03      STA #033B
0110 07D1 BD 3C 03      STA #033C
0111 07D4 A9 00        LDA #00
0112 07D6 F0 02        BEQ D1RL2
0113 07D8 A9 10        D1RL LDA #10
0114 07DA BD 3E 03      D1RL2 STA #033E
0115 07DD 20 7D D8      JSR #D87D
0116 07E0 4C FF B3      JMP #B3FF
0117 07E3
0118 07E3
0119 07E3
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0121 07E3
0122 07E3
0123 07E3
0124 07E3
0125 07E3
0126 07E3 A5 34
0127 07E5 38
0128 07E6 E9 E3
0129 07E8 B5 34
0130 07EA B5 C7
0131 07EC A5 35
0132 07EE E9 00
0133 07F0 B5 35
0134 07F2 B5 C8
0135 07F4 B5 72
0136 07F6 A9 4C
0137 07F8 B5 70
0138 07FA A5 34
0139 07FC B5 71
0140 07FE A0 00
0141 0800 B4 5C
0142 0802 A9 07
0143 0804 B5 5D
0144 0806 B1 C7
0145 0808 91 C7
0146 080A C8
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114
```


Once located the program allows you to carry out the following:

List the directory of either drive or both. The command is `> [Dn];` the brackets must not be typed, and Dn is the drive number. If no number is given both directories are listed. If no number is given both directories are listed. If a number greater than 1 is typed a syntax error will be given. The listing can be temporarily halted by pressing the space key, and continued by pressing it a second time.

Load any program from the directory listing by placing the cursor on the line which contains the required program, and pressing the Return key. Syntax is checked so that the routine only works from a normal directory listing. Program loading will only take place if a drive number is specified in the directory listing command.

mode, so do not try the commands from a Basic program as a syntax error will result.

To set up the program in your machine, first enter the Basic program given in listing 2 which lists the instructions and calls the relocation routine. Enter the monitor by typing Sys4, and key the machine-code routine starting at location \$0700 — see listing 1. If you want an Editor-Assembler you might like to enter the program that way.

Finally save the whole program from the monitor by typing

use S "1:if saving on drive 1. The program can now be loaded as a Basic Program and run in the usual way.

For those who are not familiar with

machine-code programming, a Basic loader version given in listing 3.

THE MAZE GAME by Ian Payton of Winnersh, Berkshire makes full use of the Pet's graphics characters and cursor controls although you may be able to adapt it to a computer such as the Sharp MZ-80K by changing some of the Poke addresses. For those who wish to do this, the Pet's top, left-hand screen address is 32768 and the screen is 40 by 25 blocks.

The aim of the Maze is to go round the maze in as short a time as possible, incurring as few faults as possible.

Tape of this program or more information can be provided: please telephone Wokingham (0734) 7897775. 

[illegible][illegible]

TANDY FORUM



Moon Lander

WRITTEN IN BASIC for a TRS-80 level II, the Moon Lander program by Ian Butcher of Laindon, Essex is in three sections. Section 1 is a simple representation of the flight from the Earth to the Moon. Section 2 is the orbit of the lander with the 5,000ft. level marked.

The descent from 20,000ft. to 5,000ft. also occurs during section 2. It gives the player the opportunity to slow the descent to a reasonable speed for section 3, which is from 5,000ft. to the landing. This stage draws a random Lunar landscape.

During section 3 the player can fly the lander off screen right or left to a new random lunar landscape, as long as there is enough fuel. At the harder levels there is not enough fuel and the player must get down on the initial landscape.

The program uses the TRS-80 set and reset facility to draw the lander and the landscape. Because the program is in Basic the graphics have been kept relatively simple to maintain reasonable speed of play. The program occupies less than 4K of RAM and should be fairly easy to modify for other memory-mapped micros.

The main features of the program are as follows:

Line 12 ensures that if the crash graphics are off the video map then the program jumps to the lander-destroyed routine.

Lines 20-90 are the instructions.

Lines 110-120 set the level of difficulty.

Lines 125-145 form a short routine depicting the Earth-Moon flight. They may be omitted without detriment to the program.

Line 240 initialises values: HH, height; S, speed; RA, divisor for screen co-ordinates. Lines 250-380 form a routine to draw orbiting lander.

Line 340 looks for start of descent.

Lines 390-430 are the main program loop, and look for cursor key input.

Lines 500-520 form a speed-reduction sub-routine.

Lines 600-640 form a move-left subroutine, which also redraws landscape during section if lander moves off screen.

Lines 700-740 form a move-right subroutine.

Lines 800-840 form an instrument-readout subroutine.

Lines 900-990 form a subroutine to increment

(continued on page 144)

```

5 REM A BASIC LUNAR LANDER PROGRAM BY IAN BUTCHER
10 CLS
12 ON ERROR GOTO 2180
15 T=0
20 PRINT"YOU ARE THE PILOT OF A LUNAR LANDER"
30 PRINT"YOU CAN 'FLY' THE LANDER BY USING THE UP, LEFT,"
40 PRINT"AND RIGHT CURSOR KEYS. THE UP KEY WILL"
50 PRINT"REDUCE YOUR SPEED AND RATE OF DESCENT."
60 PRINT"TO COMMENCE THE LANDING USE THE DOWN"
70 PRINT"CURSOR KEY. TO LAND SUCCESSFULLY YOUR"
80 PRINT"SPEED MUST BE LESS THAN TWENTY FEET/SEC. ON IMPACT"
81 PRINT"THE RADAR DISPLAY IS IN TWO STAGES -- FROM 20000 FT. TO 5000 FT"
82 PRINT"AND THEN FROM 5000 FT TO GROUND LEVEL "
83 PRINT"YOU MUST REDUCE SPEED DURING STAGE ONE "
84 PRINT"IF YOU CANNOT LAND YOU CAN MOVE LEFT OR RIGHT TO A NEW SITE"
85 PRINT"BY USING THE LEFT OR RIGHT CURSORS (IF YOU HAVE ENOUGH FUEL)"
90 INPUT"TO COMMENCE PRESS THE ENTER KEY";S$
100 CLS
110 PRINT:PRINT:PRINT"ENTER YOUR SKILL LEVEL (1 TO 5) --- 5 IS EASY 1 IS
HARD "
115 IF A=5OR A=4 OR A=3 THEN F=500:GOTO125
118 IFA=2THEN F=1400
120 IFA=1 THEN F=3000
125 CLS
130 PRINT@190,"MOON";PRINT@110,"EARTH";
135 FOR V=5TO0STEP-1:X=126:SET(X,Y):FORT=1TO50:NEXT:RESET(X,Y):NEXT
140 FORX=127TO0STEP-1:Y=0:SET(X,Y):FORT=1TO50:NEXT:RESET(X,Y):NEXT
145 FOR V=0TO8:X=0:SET(X,Y):FORT=1TO50:NEXT:RESET(X,Y):NEXT
150 CLS
170 PRINT:PRINT"COMMAND MODULE TO LANDER"
180 PRINT:PRINT"YOU ARE NOW ENTERING ORBIT"
185 FORTT=1TO500:NEXT
190 PRINT:PRINT:PRINT"THE COMPUTERS HAVE CLOSED DOWN"
195 FORTT=1TO500:NEXT
200 PRINT:PRINT:PRINT"YOU MUST LAND THE MODULE YOURSELF"
205 FORTT=0TO500:NEXT
210 PRINT:PRINT:PRINT"YOU WILL SEE THE RADAR PICTURE SOON"
215 FORTT=0TO500:NEXT
220 PRINT:PRINT:PRINT"GOOD LUCK COMMANDER"
230 FORT=1TO500:NEXT
240 CLS:HH=20000:S=500:RA=434.5:BR=10
250 PRINT@960,"5000 FT. -----";
260 GOSUB800
290 B=1:C=2:D=3:E=3:I=4:G=5:H=0:J=4:K=6
300 FORX=0TO122:GOSUB 5000
310 FORT=1TO100:NEXT
320 GOSUB 6000
330 B=B+2:C=C+2:D=D+2:H=H+2:J=J+2:IF J>127THEN 290 ELSE 340
340 IF PEEK(14426)=16 THEN GOTO 360
350 NEXT
355 GOTO290
360 E=E+2:I=I+2:G=G+2:K=K+2
370 IF K>47 THENK=47:G=46:I=45:E=44
380 GOSUB 5000
390 IF PEEK(14426)=8GOSUB 500
400 IFPEEK(14426)=32 GOSUB 600
410 IFPEEK(14426)=64 GOSUB 700
420 GOSUB 900
430 GOTO 390
500 IF T>999 THEN S=S-(7.5-(F*.001)-2)*A:GOTO506
505 S=S-(50-(F*.001)-2)*A
506 F=F-(50/A)
510 GOSUB 905
520 RETURN
600 GOSUB 6000
610 B=B+2:C=C+2:D=D+2:H=H+2:J=J+2:IF H<0AND HK<5000THEN GOSUB 4000:H=123:B=124
:C=125:D=126:J=127
615 IF H<0 THEN H=123:B=124:C=125:D=126:J=127
620 F=F-(50/A):GOSUB800
630 GOSUB5000
640 RETURN
700 GOSUB6000
710 B=B+2:C=C+2:D=D+2:H=H+2:J=J+2:IFJ>127AND HK<5000THEN GOSUB 4000
:H=0:B=1:C=2:D=3:J=4
715 IF J>127 THEN H=0:B=1:C=2:D=3:J=4
720 F=F-(50/A):GOSUB800
730 GOSUB5000
740 RETURN
800 PRINT@1,"HEIGHT "HH;
810 PRINT@20,"SPEED "S;
815 IF F<150 THEN PRINT@420,"FUEL LOW ";
820 PRINT@45,"FUEL "F;
830 IF F<0 GOTO2000
840 RETURN
900 IF T>999 THEN S=S+1:GOTO905
902 S=S+5
905 T=T+1:TT=TT+1
910 IF T<900 AND HK<5000 GOSUB4000:T=900:TT=900
930 HH=HH-S:RR=INT(HH/RA):IF RR=YR THEN 940 ELSE 935
935 GOSUB6000
940 E=(44-RR):I=(45-RR):G=(46-RR):K=(47-RR):YR=RR
955 IFEC3 THEN E=3:I=4:G=5:K=6
960 GOSUB800
970 GOSUB5000
980 IF POINT(H,K+1)=-1 ANDPOINT(J,K+1)=-1THEN3000 ELSE 990
990 IF POINT(H,K+1)=-1THEN 2000
1000 IF POINT(J,K+1)=-1 THEN 2000
1010 RETURN
2000 IF F<0THEN 2010 ELSE 2150
2010 FORX=0TO42:GOSUB6000
2020 E=E+1:I=I+1:G=G+1:K=K+1:FOR DT=0TO50:NEXT
2030 GOSUB 5000
2150 GOSUB6000
2160 FORX=1TO5:B=B-1:D=D+1:E=E-1:I=I-1:G=G-1
2170 GOSUB5000
2175 NEXT:FOR DT=1TO500:NEXT
2180 CLS:PRINT@320,"YOU ARE VERY DEAD !";
2190 PRINT@384,"THE LANDER IS DESTROYED"
2200 GOTO3020
3000 FOR T=1TO500:NEXT:IF S<20 THEN CLS ELSE 2150
3010 PRINT:PRINT:PRINT"CONGRATULATIONS YOU HAVE LANDED"
3020 INPUT"IF YOU WISH TO HAVE ANOTHER GO PRESS ENTER ";S$
3030 GOTO 10
4000 CLS:RANDOM
4010 FORX=0TO125STEP3:Y=RND(9)+38:SET(X,Y):SET(X+1,Y):SET(X+2,Y):NEXT
4020 RA=111
4030 BR=1
4040 RETURN
5000 SET(H,K):SET(B,I):SET(C,E):SET(B,G):SET(C,G):SET(D,I):SET(D,G):SET(J,K)
5010 RETURN
6000 RESET(H,K):RESET(B,I):RESET(C,E):RESET(B,G):RESET(C,G):RESET(D,I):RESET(D,G)
:RESET(J,K)
6010 RETURN

```


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(continued from page 141)

speed, calculate screen co-ordinates, select section 2 and move lander down, if appropriate.

Lines 980-1010 test to see if lander is on level ground

Lines 2000-2200 are the crash routine.

Lines 3000-3030 select repeat game.

Lines 4000-4040 generate the landscape for section 2, and reassigns new RA.

Lines 5000-5010 are the set subroutine.

Lines 6000-6020 are the reset subroutine.

The intention was to write a Basic lunar lander which strikes a reasonable balance between graphics and speed. The program is sophisticated enough to be playable by a wide variety of age groups as it stands, but should also provide an incentive for the more accomplished programmer to modify and improve on it. Apart from the set, reset facility the program uses Basic in a way which should allow fairly easy transportation to 6502-based micros.

User graphics

TWO RELATED PROGRAMS come from John Middleton of Sale, Cheshire. The first prints a £ sign which is not available in the character set of the Tandy Linewriter VII. The other allows any user-defined character to be printed.

User Definable Characters forms characters row by row. Inputting a 1 causes a dot to be printed at a particular point; inputting a 0 causes a blank space to be printed.

Name finder

IN TANDY FORUM January 1982, M L Arnautov suggests a clever method of loading a system tape with an unknown name. There is, however, a much simpler alternative, writes Tony Edwards of Northwood, Middlesex. Place the tape in the recorder as you would for a normal load and then run the following program

```
10 INPUT#-1,A$;A$;NEW
```

You will be rewarded with the name of the unknown program. Write it down this time, before you forget it again.

If the program on the tape is in Basic the single-character name is printed, but if it is a system tape the full program name is output preceded by the letter U, the machine-code identifier. If the tape was not a program tape at all but a data tape the output is the first piece of data.

This program also responds to Tiny Pascal program tapes as if they were system tapes.

Data separator.

```
10 DATA "THESE","ARE","THE","FIRST","TEN","ITEMS",
"OF","THE","DATA","LIST","AND","WE","WOULD","NORMALLY",
"CONTINUE","READING","HERE","BUT","NOW","WE'VE","CONTINUED",
"READING","HERE","INSTEAD"
20 GOSUB50:GOSUB 60
30 GOSUB50:POKE16639,107:POKE16640,67:GOSUB60
40 PRINT:PRINT:LIST10
50 PRINT:PRINT:RESTORE:FORI=1TO10:READA$:PRINTA$;
" ";:NEXT:RETURN
60 PRINT:FORI=1TO7:READA$:PRINTA$;" ";:NEXT:RETURN
```

Pound sign.

```
93 REM *****
94 REM *** POUND SIGN PROGRAM ***
95 REM *** FOR USE WITH LINE PRINTER VII ***
96 REM *** WRITTEN BY J.MIDDLETON ***
97 REM *****
100 DATA 200,190,169,162,196: DATA FOR POUND SIGN
105 LPRINT CHR$(18): PUT LINE PRINTER VII IN GRAPHICS MODE
110 FOR I=0 TO 5:5 COLUMNS PER CHARACTER
115 READ J
120 LPRINT CHR$(J):PRINT 1 COLUMN OF POUND SIGN
125 NEXT J
130 LPRINT CHR$(30): PUT PRINTER BACK IN CHARACTER PRINT MODE
140 END
```

User Definable Characters.

```
10 CLEAR2000:SA=15360:EA=15744
20 REM *****
30 REM *** SA=TOP LEFT OF SCREEN ***
40 REM *** EA=ADDRESS 7 CHARACTERS BELOW TOP LEFT OF SCREEN ***
50 REM *****
60 CLS
70 A$=INKEY$
80 IF A$="1" OR A$="0" THEN 100
90 GOTO70
100 IF T=5 THEN PRINTCHR$(13):T=0:D=D+1: LINE FEED IF 5 CHARACTERS PRINTED
110 IF D=7 THEN 180
120 IFA$="1"THEN PRINTCHR$(191):ELSEPRINT".";
130 T=T+1
140 GOTO70
150 REM *****
160 REM *** COMPUTE CHARACTER PATTERN IN BINARY ***
170 REM *****
180 FORI=EA+J TO SA+J STEP-64
190 IF PEEK(I)=191THEN A$(J)=A$(J)+"1" ELSE A$(J)=A$(J)+"0"
200 NEXTI
210 J=J+1
220 IF J=5 THEN 240
230 GOTO180
240 FORI=0TO4:A$(I)="1"+A$(I)
250 NEXTI
260 REM *****
270 REM *** CHANGE BINARY TO DECIMAL ***
280 REM *****
290 FORI=0TO4
300 FORJ=0TO7
310 IF VAL(MID$(A$(I),8-J,1))=1THEN V(I)=V(I)+2EJ
320 NEXTJ,I
330 REM *****
340 REM *** SCREEN OUTPUT OF ALTERATIONS TO POUND SIGN PROGRAM **
350 REM *****
360 PRINT:PRINT"REPLACE THE DATA IN LINE 100 IN THE POUND SIGN PROGRAM WITH"
370 FORI=0TO4
380 PRINTV(I);
390 NEXTI
400 PRINT:PRINT"TO REPRODUCE THE CHARACTER DRAWN ON THE SCREEN"
410 REM *****
420 REM *** OPTION OF PRINTER OUTPUT OF CHARACTER ***
430 REM *****
440 PRINT" DO YOU WANT THE CHARACTER OUTPUT TO THE PRINTER ?"
450 A$=INKEY$:IFA$=""THEN450
460 IF A$="Y"THEN 470 ELSE END
470 LPRINTCHR$(18): PUT PRINTER IN GRAPHICS MODE
480 FORI=1TO4
490 LPRINTCHR$(V(I));
500 NEXT I
```

Data separator

WHERE PROGRAMS contain long lists of items in Data statements, it is often convenient to be able to access different parts of the list independently, writes Michael Smith of Camborne, Cornwall. There are two methods which are often recommended. The data list shown here,

for example, is evidently intended to be treated as three separate data lists, but Read statements in the program will treat it as one huge list. Successive Reads simply take one item after another until the end of the list is reached. All that can be done to influence the process is to Restore, to start again at the beginning.

What happens if you want to go

Data separator — example data.

```
1300 REM LIST OF TELEPHONE
NUMBERS
1310 DATA "694-0220", "575-3376",
"283-9501"
1400 REM LIST OF DISTANCES IN MILES
1410 DATA 5,8,4,2,9,5,4,6,7,4
1500 REM LIST OF NAMES
1510 DATA "JIM", "FRED", "JOE", "TOM"
```


straight to the third list of names? One well-known book on programming for the TRS-80 recommends either that you should be aware of the number of items in each group, and just perform the appropriate number of dummy Reads until you reach the part you want. Alternatively you can precede each group with a unique code and then search for that code, again by Reading until you find it. The second method requires that the code must not otherwise be a data item anywhere in the list. Where the part you want is hidden in the middle of a long data list, both methods can take ages.

There is also a mysterious "imaginary pointer" which points to the next data item after a Read. The Pointer Finder

program helps you to find the pointer. When it is run, the screen displays the following text:

THESE ARE THE FIRST TEN ITEMS OF THE DATA LIST AND WE WOULD NORMALLY CONTINUE READING HERE

THESE ARE THE FIRST TEN ITEMS OF THE DATA LIST BUT WE'VE CONTINUED READING HERE INSTEAD

followed by a listing of Data line 10 so that you can see what has happened.

On the first occurrence of Gosub50, in line 20, the subroutine reads the first 10 data items from the list and prints them. A pointer stored in locations 16639 (LSB) and 16640 (MSB) now points to the comma delimiter after the last item read, that is, to the comma before "and".

The statement Gosub60 in line 20 then reads the next seven items and prints them, just as you would expect.

The procedure is repeated in line 30, but this time, after reading and printing the first 10 items as before, the pointer is reset so that it points to location 17259 ($=67 \times 256 + 107$) in memory. As it happens, this location is where the comma before "but" is stored. When subroutine 60 is performed this time, it Reads and Prints the seven items beginning with "but".

So in order to read selectively any part of a data list, find out where the comma before the first item that you want is stored, or the blank space at the start of a Data statement if that is where you want to begin. Set the pointer to that address and start to Read.

One easy way to find the location you require is to count the data items before the one you want to begin on, read items up to that point with a For-Next loop, and do a Peek (16639), Peek (16640) to see where the pointer is now. Then use those numbers in your program. It certainly beats reading the whole data list into an array and accessing it by indexing — that is just a good way to run out of memory.

Unknown tape loader

THIS PROGRAM by J A E Bowen of Tamworth, Staffordshire, was originally conceived to permit the loading of system tapes from the second cassette on one of the original Video Genie microcomputers. The program was written in Basic so that it could be loaded from the second cassette on a Video Genie if the internal cassette is faulty. This model had a fixed-level internal cassette only, and it could sometimes be difficult to load a system tape from another source because of recorded level differences.

The main problem was not only to provide a machine-language routine which would allow a system tape to be loaded from the second cassette, but, with only 16K of RAM available, to locate the program in a position where it could not be overwritten and hence abort the loading process. The solution adopted was to initialise the system load from the program and, once past the cassette selection part of the internal routine, jump back into ROM. The routine in the RAM is then redundant and it does not matter if it is overwritten.

The program will load system tapes with unknown names and the selection of either cassette is permitted. As an additional bonus, the name which has been read from the tape during loading is also displayed.

If memory allows, the USR routine may be located in a part of the memory where it will not be overwritten and may be used more than once by calling System and the appropriate entry address displayed by the program.

Unknown tape loader.

```

10 CLS
20 PRINT
30 PRINT"*****"
40 PRINT"*   LOADER FOR UNKNOWN SYSTEM TAPES,   *"
50 PRINT"*   EITHER CASSETTE.                   *"
60 PRINT"*****"
70 '
80 DIM A(37):N=0
90 L=219:M=127:K=32731
100 PRINT
110 INPUT"CHANGE LOCATION OF USR ROUTINE";A#
120 IF LEFT$(A#,1)="Y" THEN GOTO 140
130 IF LEFT$(A#,1)="N" THEN GOTO 180 ELSE 110
140 INPUT"ENTER NEW LOCATION";K
150 IF K<20443 OR K>65498 GOTO 160 ELSE GOTO 180
160 PRINT"NEW LOCATION >20443 AND <65498"
170 GOTO 140
180 M=INT(K/256):L=K-256*M
190 KK=K
200 IF KK>32767 THEN KK=KK-65536
210 FOR X=0 TO 36:READ A(X):POKE KK+X,A(X):NEXT X
220 PRINT
230 PRINT"CASSETTE 1      /";L+256*M
240 PRINT"CASSETTE 2      /";L+256*M+5
250 PRINT"END OF USR CODE IS AT";L+256*M+37
260 PRINT:PRINT
270 PRINT"FOR INSTRUCTIONS TYPE <I>"
280 PRINT"TO LOAD SYSTEM TAPE PRESS ANY KEY"
290 S$=INKEY$:IFS$="" THEN GOTO 290
300 IFS$<"I" GOTO 400
310 CLS
320 PRINT:PRINT
330 PRINT"TO LOAD MACHINE-LANGUAGE (SYSTEM) TAPE "
340 PRINT"PRESS ANY KEY AFTER SETTING UP TAPE IN CASSETTE."
350 PRINT"THE TAPE WILL LOAD WITH USUAL INDICATIONS AND FINAL PROMPT"
360 PRINT"*. TO RUN LOADED PROGRAMME TYPE / AND NEWLINE AS NORMAL."
370 GOTO 410
380 PRINT
390 PRINT"1 OR 2 ONLY"
400 CLS
410 PRINT:PRINT
420 PRINT"SELECT CASSETTE 1 OR 2";
430 INPUT A
440 GOSUB 630
450 PRINT
460 PRINT"LOADING PROGRAMME HAS NAME ";
470 IF N<0 GOTO 530
480 GOTO 530
490 POKE 16526,L:POKE 16527,M
500 RETURN
510 POKE 16526,L+5:POKE 16527,M
520 RETURN
530 Q=USR(0)
540 PRINT"**** NOT EXPECTED FORMAT"
550 PRINT
560 PRINT"TO LOAD SYSTEM TAPE PRESS ANY KEY":N=N+1
570 DATA 243,175,40,3,243,62,49,205,18,2
580 DATA 205,150,2,205,53,2,254,85,32,13,6
590 DATA 6,205,53,2,205,51,0,16,248,195
600 DATA 234,2,205,248,1,201
610 GOTO 290
620 END
630 IFA<10RA>2 THEN GOTO 380
640 IFA=1 THEN GOSUB 490 ELSE GOSUB 510
650 GOTO 450

```


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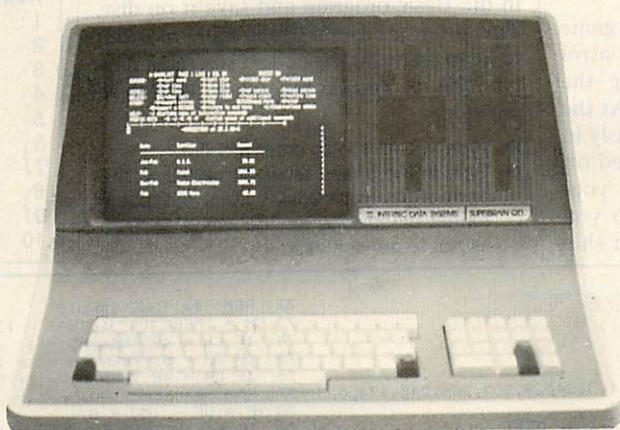
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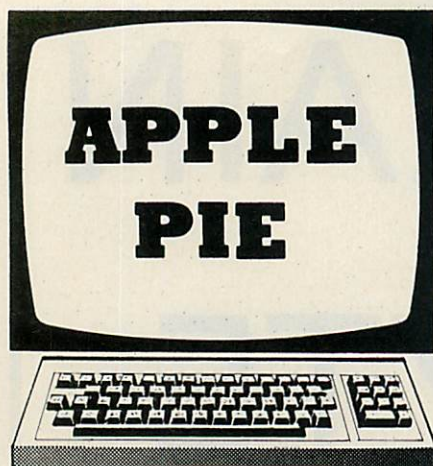
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Galaxy Invaders

GALAXY INVADERS was written by Kevin Irving of Carlisle on an Apple II with Apple DOS. It requires 32 to 48K of memory.

Galaxy Invaders is a fast, difficult game for Space Invader addicts. You control your laser right and left, zapping the Hell's Angels flying down at you. At the same time they are firing continuously in your direction. When you have killed off one fleet you are informed that your commander's ship is in trouble, so you must then save him by docking your ship

with his. By this time you are under attack again by some more Hell's Angels.

The program incorporates superb sound and graphics. Background stars give a three-dimensional effect to make the action more realistic. Multicoloured intergalactic explosions, plenty of sound, and fast graphics make a very interesting game.

You use two sets of keys: set 1 controls your movement and firing when the invaders attack; set 2 controls your moves when you are docking your ship.

Set 1

1 moves you left
3 moves you right
0 fires a laser

Set 2

W moves you up
Z moves you down
Right-arrow key moves you forwards

To set up the game you must first type in the Basic program and save it on disc. This program uses a shape table in order to keep up its high speed so you must now type this in. You should follow the following steps:

- Type in Call-151 to enter monitor.
- Type in the shape table by replacing the dash signs with colons. Use the same format of spacing as the listing does so as not to get confused.

- Type 3D0G.
- You are now back in Basic. You can save the shape table on disc using the following line:
BSAVE GAL-TT, A\$4000, L\$1B0

Now you may run your program which you saved on disc, and play Galaxy Invaders. When typing in the Basic listing, shorten the Rem statements in lines 71, 137 and 157.

CH — Keyboard scan.

CV — Vertical position of the commander when you dock your ship.

DS — The number of points you must get to dock your ship; it starts at 40 and doubles each time you attempt to dock.

FI — A1 in this location indicates that you want to fire; otherwise FI will equal 0.

FQ and FR — The co-ordinates of your missile, FQ for horizontal, FR for vertical.

Galaxy Invaders shape table.

Number	Description
1	Your ship
2	Hell's Angel Invader
3	Your fire
4	Invaders' fire
5	Explosion
6	Docking ship, your commander
7	
8	Docking ship, your ship
9	
10	Docking ship, your thrust

Galaxy Invaders.

```

24 REM ** SET UP SOUND
25 DATA 173,48,192,136,208,5,206,1,3,240,9,202,208,245,174,0,3
  ,76,2,3,96,0,0
26 FOR I = 770 TO 792: READ J: POKE I,J: NEXT
27 REM ** SET SHAPE TABLE
28 POKE 232,00: POKE 233,64
29 REM ** LOAD TABLE
30 PRINT : PRINT CHR$(4); "BLOAD GAL-TT,A$4000"
31 SCALE= 1: ROT= 0
32 REM ** SET UP VARIABLES
33 OP = 140: FR = - 1: IN = - 1: MI = - 1: SC = 0: FI = 0: MD = 0: M
  J = 0: NJ = 0: DS = 40
34 REM ** INSTRUCTIONS
35 HOME
36 PRINT "***** GALAXY INVADERS *****";
37 PRINT "***** GALAXY INVADERS *****";
38 PRINT "***** GALAXY INVADERS *****";
39 PRINT " THE GALAXY IS BEING INVADED BY BEINGS"
40 PRINT "FROM ANOTHER SOLAR SYSTEM . THEY HAVE"
41 PRINT "UNLIMITED HIGH POWER MISSILES WHICH "
42 PRINT "CAN DESTROY YOU INTO MILLIONS OF LITTLE"
43 PRINT "PIECES.": PRINT
44 PRINT "YOU ONLY HAVE ONE SHIP AND ONE LIFE"
45 PRINT "WHEN INVADERS ATTACK,PRESS"
46 PRINT " '0'-TO FIRE"
47 PRINT " '1'-TO MOVE LEFT"
48 PRINT " '3'-TO MOVE RIGHT": PRINT
49 PRINT " WHEN YOU DOCK YOUR SHIP,PRESS"
50 PRINT " W-TO MOVE UP": PRINT " Z-TO MOVE DOWN"
51 PRINT : PRINT " RIGHT ARROW TO MOVE FORWARDS"
52 INVERSE
53 VTAB 22: PRINT "PRESS THE SPACE BAR TO START THE ATTACK."
54 NORMAL
55 CH = PEEK ( - 16384) - 128: IF CH < > 32 THEN 55
56 HOME : VTAB 20
57 VTAB 23: HTAB 1: PRINT "SCORE "; SC
58 REM ** SET UP SCREEN
59 HGR
60 FOR ST = 1 TO 150: HCOLOR= ( RND (9) * 7) + 1: HPLLOT RND (9)
  ) * 280, RND (9) * 160: NEXT
61 REM ** PLAY INTRODUCTION
62 POKE 768,50: POKE 769,100: CALL 770
63 POKE 769,100: POKE 768,80: CALL 770
64 PRINT CHR$(7);
65 FOR I = 1 TO 4
66 POKE 768,50: POKE 769,50: CALL 770
67 POKE 768,200: POKE 769,50: CALL 770
68 FOR P = 1 TO 50: NEXT : NEXT
69 POKE 768,100: POKE 769,100: CALL 770
70 XDRAW 1 AT 140,157
71 REM
72 REM ** TAKE INPUTS
73 CH = PEEK ( - 16384) - 128
74 IF CH = 49 THEN MO = 1
75 IF CH = 51 THEN MO = - 1
76 IF CH = 48 THEN FI = 1: POKE - 16368,0
77 REM ** MOVE YOU
78 YP = OP - (MO * 8)
79 IF YP > 274 THEN YP = 274
80 IF YP < 6 THEN YP = 6
81 XDRAW 1 AT OP,157
82 XDRAW 1 AT YP,157: OP = YP
83 GOSUB 117
84 REM ** MOVE YOUR FIRE
85 IF FR < 0 AND FI = 1 THEN FI = 0: GOTO 88
86 IF FR = > 0 THEN 89
87 GOTO 95
88 FR = 155: FQ = YP: GOTO 92
89 FR = FR - 30
90 XDRAW 3 AT FQ,FS
91 IF FR < 0 THEN 95
92 XDRAW 3 AT FQ,FR
93 FS = FR
94 GOSUB 114
95 REM ** IS THERE AN INVADER
96 IF IN < 0 THEN IN = 5: JN = RND (9) * 279: FU = RND (9) * 11
  : XDRAW 2 AT JM,IM
97 REM ** MOVE INVADER
98 IN = IN + 5
99 ON FU GOSUB 147,148,149,150,151,152,153,154,155,156
100 XDRAW 2 AT JM,IM
101 IF IN > 155 THEN IN = - 1: GOTO 106
102 IF JN < 10 THEN JN = 270
103 IF JN > 270 THEN JN = 10
104 XDRAW 2 AT JN,IN
105 JM = JN: IM = IN
106 REM ** INVADERS FIRE
107 IF MI < 0 THEN MI = 1: MJ = JM: NJ = IM: XDRAW 4 AT MJ,NJ: MK =
  MJ: NK = NJ
108 NJ = NJ + 20: MJ = MJ + ( SGN (YP - JM) * 18)
109 XDRAW 4 AT MK,NK
110 IF MJ > 279 OR MJ < 0 OR NJ > 159 THEN MI = - 1: GOTO 73
111 XDRAW 4 AT MJ,NJ
112 MK = MJ: NK = NJ
113 GOTO 73
114 REM ** HAVE YOU GOT A HIT
115 IF JN + 8 > FQ AND JN - 8 < FQ AND IN + 16 > FR AND IN - 22
  < FR THEN 120
116 RETURN
117 REM ** HAVE THEY HIT YOU
118 IF MJ + 7 > YP AND MJ - 7 < YP AND NJ > 145 THEN 128
119 RETURN
120 REM ** YOU HIT AN INVADER
121 SC = SC + 10
122 XDRAW 2 AT JN,IN
123 FI = 0: IN = - 1
124 XDRAW 3 AT FQ,FR

```

** INVADING ROUTINE **

FS — Previous vertical position of your missile.
 FU — A random number between 0 and 10 inclusive, which will select a course for the invaders, see lines 146 to 156.
 JM and IM — Previous co-ordinates of invader; JM for horizontal, IM for vertical.
 JN and IN — Co-ordinates of invader: JN for horizontal, IN for vertical.
 MI — Equal to -1 if invaders are not firing.
 MJ and NJ — Co-ordinates of invaders' missiles: MJ for horizontal, NJ for vertical.
 MK and NK — Previous co-ordinates of invaders' missiles: MK for horizontal, NK for vertical.
 MO — Your direction of movement: -1 indicates left, 1 indicates right.
 OP — Your previous horizontal position.
 SC — Your score.
 YP — Your horizontal position.
 YH — Docking ship, your horizontal position.
 YV — Docking ship, your vertical position.
 ZH — Docking ship, your previous horizontal position.
 ZV — Docking ship, your previous vertical position.

The Rems in the listing explain what each part of the program does. The shape table is stored in high resolution page 2, and high resolution page 1 is used for playing the game. To make the game harder or easier you could change:

- the invader movement functions in lines 146 to 156;

- they multiply-by-eight in line 78 to another value, to change speed;
- line 98, which controls the rate at which the invaders come down;
- line 203, which controls your commander's speed when you are docking your ship.

File parameter finder

HAVING RECENTLY obtained an Apple 2 Plus with a disc drive, DOS 3.3, Allan Ogg of Dumbarton noticed that you are left out in the cold if you want to disassemble a machine-code program or

inspect a shape table if these are stored on disc and have been saved by someone else, e.g., by a software house or as on the system master diskette.

You can BLoad to a specified address, but you still have no idea of the length of the file, and a disassembled listing at the wrong addresses is very messy. This information is stored on the disc, so this program, which occupies less than 1K, will retrieve it.

The program uses the RWTS sub-
(continued on next page)

Binary file BSave parameter finder.

```

5 TEXT : HOME : SPEED= 255: VTAB 7: PRINT "BINARY FILE 'BSAVE' PARAMETER
  FINDER.": PRINT
10 BS = 8192: BE = 8221: DB = 8222: T = 8205: S = 8206: P = 11: Q = 221: R = 35
20 FOR I = BS TO BE: READ X: POKE I, X: NEXT
30 INPUT "FILENAME (NONE CANCELS) ": F$: IF F$ = "" THEN 220
40 GOSUB 1000
50 FOR I = P TO Q STEP R: FE = DB + I: IF PEEK (FE) = 255 THEN 100
60 IF PEEK (FE + 2) = 4 OR PEEK (FE + 2) = 132 THEN 70
65 GOTO 100
70 N = 3: FOR J = 1 TO LEN (F$)
80 IF CHR$ (PEEK (FE + N) - 128) < > MID$ (F$, J, 1) THEN 100
90 N = N + 1: NEXT J: IF PEEK (FE + N) = 160 THEN 130
100 NEXT I
110 IF L1 = 0 AND L2 = 0 THEN PRINT "FILE NOT FOUND!": GOTO 220
120 POKE T, L1: POKE S, L2: GOTO 40
130 POKE T, PEEK (FE): POKE S, PEEK (FE + 1): GOSUB 1000
140 POKE T, PEEK (DB + 12): POKE S, PEEK (DB + 13): GOSUB 1000
150 AD = PEEK (DB) + L1 * 256: D = AD: GOSUB 2000: AA$ = A$
160 LE = L2 + PEEK (DB + 3) * 256: D = LE: GOSUB 2000: L$ = A$
170 PRINT : PRINT "PARAMETERS"
180 PRINT : PRINT "ADDRESS = " TAB (20): AD: TAB (30): AA$
190 PRINT "LENGTH = " TAB (20): LE: TAB (30): L$
200 DATA 169,32,160,9,32,217,3,96,0,1,96,1,0,17,15,26,32
210 DATA 30,32,0,0,1,96,0,96,1,0,1,239,216
220 END
1000 CALL BS: L1 = PEEK (DB + 1): L2 = PEEK (DB + 2): RETURN
2000 H$ = "0123456789ABCDEF": A$ = ""
2010 P = INT (D / 16): Q = D - 16 * P: A$ = MID$ (H$, Q + 1, 1) + A$: IF P >
  0 THEN D = P: GOTO 2010
2020 RETURN
  
```

```

125 SCALE= 3: FOR R = 0 TO 127 STEP 8: POKE 768,250: POKE 769,3
  : CALL 770: ROT= R: XDRAW 5 AT FQ,FR: NEXT : SCALE= 1: VTAB
  23: HTAB 1: PRINT "SCORE ": SC: ROT= 0
126 IF SC = DS THEN DS = DS * 2: GOSUB 157
127 FR = - 1: RETURN
128 REM ** YOU ARE DESTROYED
129 FOR L1 = 1 TO 3
130 POKE 769,10: POKE 768,L1 * 80: CALL 770
131 FOR L2 = 7 TO 1 STEP - 1
132 SCALE= (L2 / 2) + 1: ROT= L1 * 10
133 HCOLOR= L2
134 DRAW 5 AT YP,155
135 POKE 768,L1 * 40: POKE 769,5: CALL 770
136 NEXT : NEXT
137 REM ** END
138 FOR P = 1 TO 50: NEXT P
139 TEXT : HOME : PRINT "YOU SCORED "SC
140 VTAB 10: PRINT "DO YOU WANT ANOTHER GAME (Y/N)":
141 CLEAR :FR = FRE (0)
142 GET A$
143 IF A$ = "Y" THEN 31
144 IF A$ = "N" THEN HOME : END
145 GOTO 142
146 REM ** INVADERS MOVEMENT EQUATIONS
147 JN = JN + 3: RETURN
148 JN = JN - 4.5: RETURN
149 JN = JN - 3: RETURN
150 JN = JN + 6: RETURN
151 JN = JN - 6: RETURN
152 JN = JN + 4.5: RETURN
153 JN = JN - SIN (JN) * 20: RETURN
154 JN = JN + SIN (JN) * 20: RETURN
155 JN = JN + COS (JN) * 15: IN = IN - SIN (IN) * 20: RETURN
156 JN = JN - COS (JN) * 15: IN = IN - SIN (IN) * 20: RETURN
157 REM
  ** DOCK YOUR SHIP **
158 REM ** GIVE BRIEFING AND SET UP
159 HGR
160 PRINT : PRINT : PRINT
161 IN = - 1: MI = - 1: YP = 140: OP = 140
162 YV = 80: YH = 30: ZH = 13
163 SPEED= 75
164 PRINT "YOUR COMMANDER IS PLEASED WITH YOU FOR FIGHTING OFF
  THE ALIENS. THE COMMANDERS SHIP WAS DAMAGED AND IS DRIFTIN
  G TO A DEAD ALIEN WHERE IT WILL BLOW UP. YOUR INSTRUCTIO
  NS ARE TO DOCK UP WITH THE COMMANDERS SHIP AND SAVE HIM"
165 PRINT "": PRINT "": PRINT : PRINT
166 SPEED= 255
167 REM ** SET UP SCREEN
168 ROT= 0: SCALE= 1
169 XDRAW 2 AT 243,150: XDRAW 2 AT 273,150
170 ROT= 32: XDRAW 2 AT 258,147
171 CV = 40
172 ROT= 0
173 HCOLOR= 7
  
```

```

174 DRAW 7 AT 250,CV
175 HCOLOR= 5
176 DRAW 6 AT 250,CV
177 POKE 768,100: POKE 769,100: CALL 770: POKE 769,10: CALL 770
178 REM ** TAKE INPUTS
179 FOR L1 = 1 TO 4
180 CH = PEEK ( - 16384) - 128
181 IF CH = 21 THEN YH = YH + 3
182 IF CH = 87 THEN YV = YV - 2
183 IF CH = 90 THEN YV = YV + 2
184 REM ** MOVE YOU
185 IF YV > 140 THEN YV = 140
186 IF YV < 10 THEN YV = 10
187 HCOLOR= 0: DRAW 8 AT ZH,ZV: DRAW 9 AT ZH,ZV
188 DRAW 10 AT ZH - 12,ZV
189 HCOLOR= 7: DRAW 8 AT YH,YV
190 HCOLOR= 6: DRAW 9 AT YH,YV
191 IF L1 / 2 = INT (L1 / 2) THEN HCOLOR= 5: DRAW 10 AT YH -
  12,YV
192 ZH = YH: ZV = YV
193 IF L1 < 4 THEN FOR P = 1 TO 15: SO = PEEK ( - 16336): NEXT
194 REM ** CHECK FOR DOCK
195 IF YH > 247 AND YV > CV - 4 AND YV < CV + 3 THEN PRINT "WE
  LL DONE YOU HAVE SAVED HIM. YOU GET AN EXTRA 30 PTS.": FOR
  P = 1 TO 200: POKE 769,9: POKE 768, ABS (100 - P): CALL 770
  : NEXT P: SC = SC + 30: GOTO 211
196 REM ** CHECK FOR CRASH INTO COMMANDER
197 IF YH > 247 AND YV > CV - 14 AND YV < CV + 15 THEN PRINT "
  YOU CRASHED INTO YOUR COMMANDER": FOR P = 1 TO 2: FOR L = 1
  TO 200: ROT= L: SCALE= P: XDRAW 5 AT 250,CV: POKE 769,3: POKE
  768, ABS (100 - L): CALL 770: NEXT : NEXT : GOTO 138
198 REM ** CHECK FOR MISSED COMMANDER
199 IF YH > 247 THEN PRINT "YOU HAVE MISSED YOUR COMMANDERS SH
  IP SO YOU DON'T GET ANY EXTRA POINTS.": PRINT CHR$ (7): FOR
  P = 1 TO 300: SO = PEEK ( - 16336): NEXT P: PRINT CHR$ (7)
  : GOTO 211
200 NEXT
201 REM ** MOVE COMMANDER
202 HCOLOR= 0: DRAW 7 AT 250,CV: DRAW 6 AT 250,CV
203 CV = CV + 2
204 HCOLOR= 7: DRAW 7 AT 250,CV
205 HCOLOR= 5: DRAW 6 AT 250,CV
206 REM ** HAS COMMANDER CRASHED
207 IF CV > 130 THEN PRINT : PRINT : PRINT "YOU FAILED AND YOU
  R COMMANDER CRASHED": PRINT : FOR O = 1 TO 3: FOR P = 1 TO
  64 STEP 8: ROT= P: SCALE= (P / 16) + 1: POKE 768, (P * 4) -
  1: POKE 769,5: CALL 770: XDRAW 5 AT 250,CV: NEXT : NEXT
208 IF CV > 130 THEN 211
209 GOTO 179
210 REM ** SET UP FOR INVADER ROUTINE & LEAVE
  DOCK SHIP
211 HGR : FOR I = 1 TO 150: HCOLOR= (RND (9) * 7) + 1: HPLT RND
  (9) * 280, RND (9) * 160: NEXT : PRINT : PRINT : PRINT : PRINT
  : XDRAW 1 AT YP,157
212 SPEED= 75
  
```


Parameter finder subroutines.

RWTS call subroutine.

JCALL-151

*2000L

```
2000- A9 20 LDA #20
2002- A0 09 LDY #09
2004- 20 D9 03 JSR $03D9
2007- 60 RTS
```

DOS IOB and device characteristic table.

```
2008- 00 BRK
2009- 01 60 ORA ($60,X)
200B- 01 00 ORA ($00,X)
200D- 11 0F ORA ($0F),Y
200F- 1A ???
2010- 20 1E 20 JSR $201E
2013- 00 BRK
2014- 00 BRK
2015- 01 60 ORA ($60,X)
2017- 00 BRK
2018- 60 RTS
2019- 01 00 ORA ($00,X)
201B- 01 EF ORA ($EF,X)
201D- D8 CLD
201E- C0 DD CPY #DD
2020- 8C C0 68 STY $68C0
```

Program data.

*2000

```
2000- A9
*
20 A0 09 20 D9 03 60
*
2008- 00 01 60 01 00 11 0F 1A
*
2010- 20 1E 20 00 00 01 60 00
*
2018- 60 01 00 01 EF D8 C0 DD
*FP
```

(continued from previous page)

routine. It should be convertible to DOS 3.2 with only a few changes to the file-search routine, as the IOB and device-characteristic table are the same format. The RWTS call locations should be easily relocated if necessary — they were placed in high-resolution screen one for simplicity.

The program first sets the RWTS subroutine to read in the first directory sector — track 17, sector 15. It then asks for a file name and enters a loop to search the seven file entries held on each direc-

Parameter finder sample run.

```
FILENAME (NONE CANCELS) BOOT13
PARAMETERS DEC. HEX.
ADDRESS = 5888 1700
LENGTH = 2288 8F0

FILENAME (NONE CANCELS) COPY.0BJ0
PARAMETERS DEC. HEX.
ADDRESS = 704 2C0
LENGTH = 267 10B

FILENAME (NONE CANCELS) FID
PARAMETERS DEC. HEX.
ADDRESS = 2051 803
LENGTH = 4686 124E

FILENAME (NONE CANCELS) FPBASIC
PARAMETERS DEC. HEX.
ADDRESS = 53248 D000
LENGTH = 12288 3000

FILENAME (NONE CANCELS) INTBASIC
PARAMETERS DEC. HEX.
ADDRESS = 4096 1000
LENGTH = 12288 3000

FILENAME (NONE CANCELS) MASTER CREATE
PARAMETERS DEC. HEX.
ADDRESS = 2048 800
LENGTH = 1791 6FF

FILENAME (NONE CANCELS) MUFFIN
PARAMETERS DEC. HEX.
ADDRESS = 2051 803
LENGTH = 6397 18FD

FILENAME (NONE CANCELS)
```

tory sector. The files are rejected if the entry is a deleted file, not binary then finally if the file-name does not match.

If the file is not found, the program reads in the next, if any, directory sector and searches again. It continues until the file is found or the directory ends. Once found, the program reads in the file's Track/Sector List from the disc, and from that it reads in the first file sector which contains the necessary information. The parameters are then printed out in decimal and hexadecimal for convenience. The copy of the program gives the parameters of binary files supplied on the system master diskette.

Source list

I BECAME AWARE of the need for this program while enhancing Apple Spiel and converting it to machine code, writes Neil Lomas of Crewe, Cheshire. The assembly-code routines are now approaching 2,000 lines and take nearly an hour to compile if producing a hard-copy listing.

When creating or amending hundreds of lines of assembly code, there is bound to come a time — however good the editor — when a hard copy of some or all of the code would be helpful. The Editor/Assembler on the DOS Toolkit will only output to the printer during the

assembly phase, which causes many errors to be printed where references are made to labels which have not yet been input.

Source List will produce a formatted listing of any part of a source text file. The formatting is semi-intelligent in that the first three spaces on any line are treated as tabs, without regard to context. This produces a listing which closely resembles the screen listing output by the editor. Six blank lines are thrown after every 60 source lines. Where only part of the source is being printed, the decision to throw blank lines depends on the line numbers, not on the number of lines.

When run, the program asks for the name of the source file and the disc drive number — the slot number is assumed to be the current one — together with the first and last line numbers to be printed. To print to the end of the file, any suitably high end line number may be given.

Although intended for use with the DOS Toolkit Assembler, it should work equally well with any assembler which stores source as serial text files. If your printer does not support line feed, you will need to change line 120. All line numbers ending in 9 may be omitted. There are no Goto's referring to Rem lines.

Source list.

```
10 REM ASSEMBLER SOURCE LISTER - N. LOMAS DEC 1981
20 GOTO 250
99 REM FINISH IF PAST END POINT
100 IF YZ > BZ THEN 500
109 REM DON'T PRINT IF START NOT REACHED
110 IF YZ < = AZ THEN 130
119 REM PRINT LF'S IF PAGE THROW DUE
120 IF 60 * INT ((YZ - 1) / 60) = YZ - 1 THEN PRINT L$;L$
;L$;L$;L$;L$
130 PRINT D$;"READ ";F$
139 REM READ NEXT CHAR FROM FILE
140 GET Z$; PRINT D$
149 REM END OF LINE IF 'RETURN'
150 IF Z$ < > CHR$(13) THEN 175
159 REM PRINT LINE IF START REACHED
160 IF YZ > = AZ THEN PRINT Y$
169 REM UPDATE LINE NO AND START NEXT LINE
170 YZ = YZ + 1;Y$ = RIGHT$( " " + STR$(YZ),4);Y$ = Y$ +
" ";Z$ = FRE(0);GOTO 100
175 IF YZ < AZ THEN 130
179 REM APPEND CHARACTER TO LINE IF NOT SPACE
180 IF Z$ < > " " THEN Y$ = Y$ + Z$;GOTO 130
189 REM ADD SPACES TO REACH NEXT TAB
190 IF LEN(Y$) < 13 THEN Y$ = LEFT$(Y$ + " ",13)
;GOTO 130
200 IF LEN(Y$) < 18 THEN Y$ = LEFT$(Y$ + " ",18);GOTO
130
210 IF LEN(Y$) < 28 THEN Y$ = LEFT$(Y$ + " ",28);GOTO
130
219 REM IF LAST TAB PASSED, ADD SPACE
220 Y$ = Y$ + Z$;GOTO 130
250 TEXT : HOME
260 INVERSE : PRINT SPC(40)
270 FOR I = 2 TO 22: VTAB I: HTAB 1: PRINT " ";: HTAB 40: PRINT
" ";: NEXT
280 VTAB 23: HTAB 1: PRINT SPC(40): VTAB 5: HTAB 2: PRINT
SPC(38);: NORMAL : POKE 33,30: POKE 32,9
290 VTAB 3: HTAB 5: PRINT "SOURCE LISTER": VTAB 12
300 INPUT "FILENAME: ";F$
310 INPUT "DRIVE NO: ";D$
320 INPUT "START LINE NO: ";AZ
330 INPUT "END LINE NO: ";BZ
340 D$ = CHR$(4);I$ = CHR$(9);L$ = CHR$(10);POKE 32,0
: POKE 33,40
350 PRINT D$;"OPEN ";F$;"D";D$
360 YZ = 1;Y$ = " 1 "
370 ONERR GOTO 500
380 PRINT D$;"PR#1"
390 PRINT I$;"K";I$;"B0N";: PRINT
400 GOTO 100
500 PRINT
510 PRINT D$;"PR#0"
520 PRINT D$;"CLOSE"
```




Sharp printer interface

THIS SHORT ROUTINE for the Sharp MZ-80K by Simon Brown of Tunbridge Wells, Kent, enables you to output codes to a printer which are otherwise unprintable. For example, the code for Escape is 27 decimal but CHR\$(27) in Basic is converted to a null by the interpreter. Any printer control codes using unprintable numbers are not readily available to the Basic programmer.

This machine-code subroutine uses subroutines in Sharp Basic SP-5025 to output one or more code numbers to the printer. For example,

```
USR (PR), 27, 65, 1
```

would send ESC A <1> to the printer, which is the Epson MX-80 instruction to set the line spacing to 1/72in. The routine should interest Sharp users because it illustrates the use of several of the Basic subroutines.

Upgrading to Z-80B

RECENT COVERAGE given to the Z-80B processor chip has led to a number of people inquiring about the possibility of replacing standard Z-80 or Z-80A central processor units in their microcomputers with the faster Z-80B, writes John Parker. The substitution is possible, but before it is carried out the following points should be noted. Whatever make or type of microcomputer is involved, the basic configuration will be the same, and the same considerations will apply.

The Z-80B CPU is functionally identical to all other versions of the Z-80. The A and B variants are simply graded examples of the basic chip. Minor variations in the production process mean that some chips are capable of working up to a higher clock frequency than others: a chip is tested to 10MHz before it is given a B designation, though Zilog will not guarantee performance above 6MHz.

The old Z-80 CPU can be unplugged and replaced by a Z-80B, and the system will continue to work perfectly well. The problems only start when the clock frequency is increased.

A complete microcomputer consists not just of a CPU but must also include ROM, RAM, I/O, etc., to enable it to

Printer interface.

```
12 REM USR(PR),exp1,exp2,...,expN is equivalent to
13 REM PRINT/P CHR$(exp1);CHR$(exp2);...;CHR$(expN);
14 REM For example,USR(PR),27,65,1 outputs ESC A <1> which sets the
15 REM line spacing for EPSON MX80 printers to 1/72".
16 REM However the advantage of the routine is that it allows you to output
17 REM codes to the printer which would normally be converted to nulls by the
18 REM BASIC interpreter.
19 REM Thus it is now possible to use the full set of printer control codes
20 REM conveniently.
21 REM NOTE-This routine uses subroutines within Sharp BASIC SP-5025.
22 REM
23 REM The following code sets up the routine and is executed by GOSUB 1000.
999 REM***** set up printer interface routine *****
1000 PR=50000:LIMIT PR
1010 FOR I=0 TO 22
1020 READ E:POKE PR+I,E
1030 NEXT
1040 E=PR+19
1050 POKE PR+15,E-256*INT(E/256)
1060 POKE PR+16,INT(E/256)
1070 RETURN
1100 DATA 205,151,22,44,205,169,25,123,205,119,60
1110 DATA 205,139,22,44,0,0,24,241,34,1,72,201
1999 REM***** Z80 source code *****
2000 REM SEND CALL 1697H ;skip first comma
2010 REM DEFB "," ;
2020 REM SEND1 CALL 19A9H ;evaluate expression into DE
2030 REM LD A,E
2040 REM CALL 3C77H ;send code to printer
2050 REM CALL 168BH ;look for comma
2060 REM DEFB "," ;if not present
2070 REM DEFW EXIT ;jump to EXIT
2080 REM JR SEND1 ;else loop back to SEND1
2090 REM EXIT LD (4801H),HL ;move text pointer past USR statement
2100 REM RET ;return to BASIC
```

store programs and data and to communicate with external devices. These peripheral devices form part of the microcomputer and must be capable of operating at the same speed as the CPU. The Z-80 has an associated family of peripheral devices — PIO, CTC, SIO, DART, etc. — which are all graded in the same way as the CPU. If a Z-80B is substituted for a basic Z-80, the clock frequency cannot be increased without upgrading the system's peripheral devices at the same time.

During an op-code fetch cycle, the first T state is used for loading program-counter address information to memory. During the memory's access time, the second T state increments the program counter. The third T state is used for loading memory output data into the instruction register or accumulator. If the memory's access time exceeds the length of the second T state, there will be no data on the memory's output bus when the processor requires it.

The length of one T state represents the microprocessor's clock period — which is 500ns. at 2MHz. At this speed, low-cost 450ns. access time memories can be used. At 6MHz, the clock period is 167ns., which is considerably less than the original memory's access time. To enable the system to work at the higher speed, it will be necessary to use memories with a shorter access time, or at least to check that the original memories have this capability.

The printed-circuit board and layout for your microcomputer will have been designed for the maximum clock frequency of the original CPU. At 6MHz,

impedances created by capacitance effects will be correspondingly less, which could be a problem if, for example, unbuffered lines are used on data/address buses and clock outputs.

Remember that changing the clock crystal may not necessarily change the clock frequency as required, which will depend on the clock chip or oscillator employed. In some cases, changing the crystal will suffice, but in others, certain other components will have to be changed to accommodate the new resonant frequency.

Nascom backgammon

IT ALWAYS SEEMS that the interesting programs are written for other people's machines writes Y. T. Ho from Kuala Lumpur, Malaysia. To modify the Backgammon program — *Practical Computing May 1981* — by Bob Snell and Barbara Colley for the Nascom 2 here are some suggestions:

- The Get command is given in the Nascom manual.
- The cursor commands for the Pet may be replaced by ASCII CHR\$(18) to CHR\$(20).
- As the number of lines on the Nascom is limited follow the printer display shown.
- To generate a truly random drive routine replace the original program lines with:

```
9 GOSUB 91:GOSUB 96:
I=RND(-G1*10):O=-1
251 G=USR (O):G1=RND(1):
IF G=0THEN 251
252 A$=CHR$ (G): RETURN
```

This samples the pseudo-random sequence RND(1) at varying intervals, depending on the time taken by the player for his responses. □



Atom EPROM programmer

THE ACORN ATOM has a vacant expansion socket inside for a utility ROM which will accommodate up to a 4K by eight-bit device, writes John Flower of Cowplain, Hampshire. The EPROM which can be fitted is the 2532, which is made by Texas Instruments and a number of Japanese suppliers. This device is a 32K chip organised as 4,000 words of eight bits. The chip is readily available for about £6.

You can program your favourite game or a useful machine-code routine on to this device so that it can become a permanent part of your computer's operating system. You could even write your own toolkit program. The 2532 EPROM is remarkably easy to program with the Atom since most of the necessary circuitry for an EPROM programmer is

already inside the Atom's VIA chip. If you decide to have a go at building this design then you will have to buy and fit the optional 6522 versatile interface adaptor chip to your machine.

For a programmer interface you only need to provide an address latch externally to address each location in turn while the data is presented and the programming operation takes place. The circuitry consists of two LS374 eight-bit latches to hold the address word plus a zero-insertion-force socket to carry the EPROM without risk of bending the pins.

Pin 21 of the 2532 EPROM is connected to +5 volts when reading data. Data is read by pulsing pin 20 low while looking at the data pins. The device works in reverse if pin 21, which is normally held to 5 volts, is taken to 25 volts. In this case data present at the data pins is programmed into the eight locations whose address is present at the address pins. This happens if pin 20 is pulsed low for exactly 50ms.

The program performs the necessary operations to copy, program and verify EPROMs. Programs to be copied from an EPROM or to be programmed into one are stored in the graphics memory from location #8400 onwards. The program is menu driven and prompts to see what operations you wish to perform.

The VIA chip writes the relevant address on to ports A and B and clocks the address latch to store the 12-bit address. Then the eight-bit data is either presented to or read from port B.

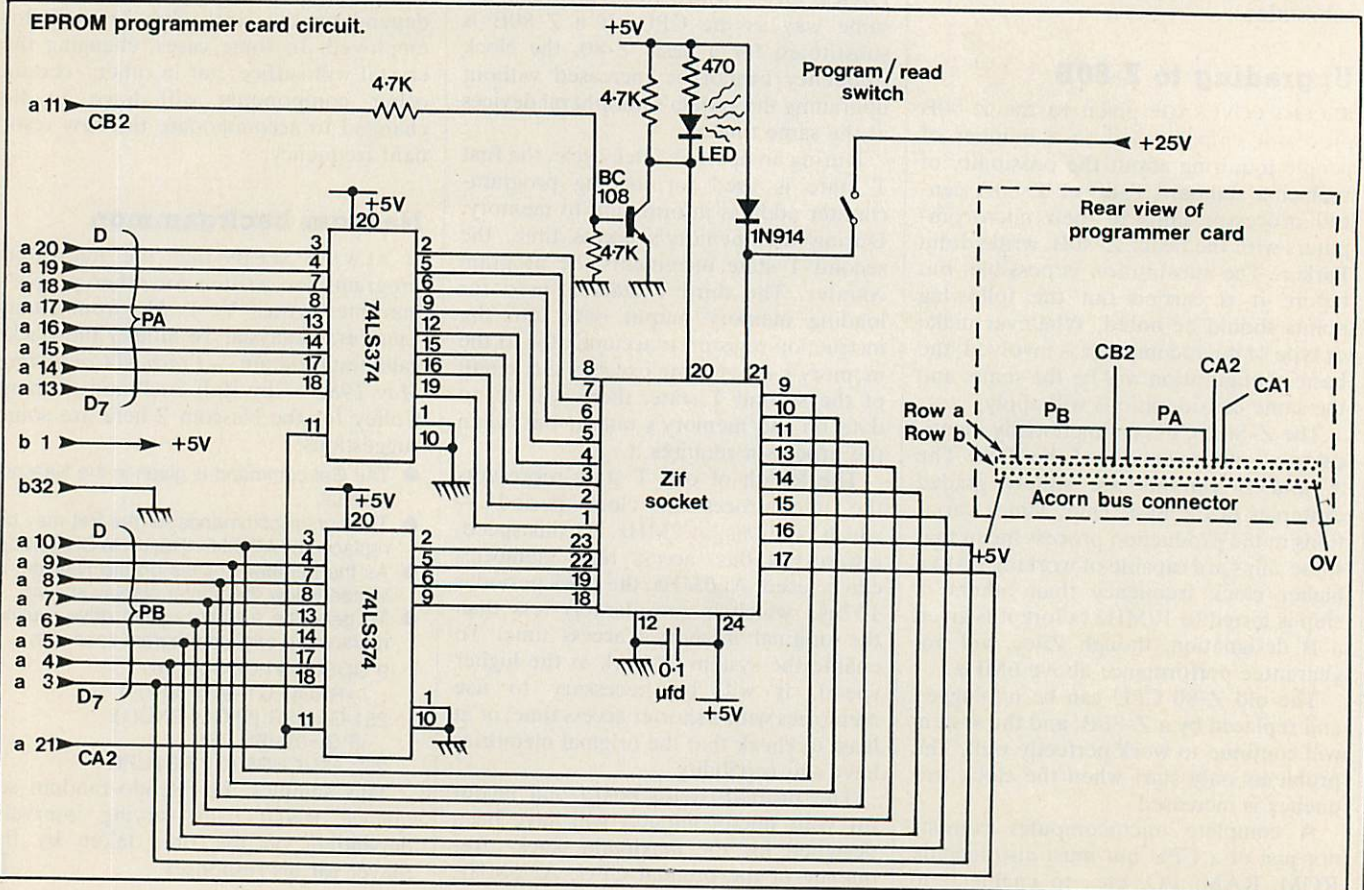
Construction of the circuit should present little difficulty. Only two integrated circuits are involved, plus four resistors, two diodes, an npn transistor and one capacitor. You will need to fit an Acorn bus connector to your computer and buy the appropriate 64-way Eurocard DIN connector mating socket.

The circuit diagram shows the bus connections that are used, viewed from the rear of the programmer card. The 64-way right-angle plug is fitted to the Atom, and the socket is fitted to a piece of Veroboard upon which the programmer is to be constructed.

The light-emitting diode serves to show that Read or Write operations are taking place. The other diode — 1N-914, or similar — ensures that +5V is connected to pin 21 of the EPROM when normal reading of the device occurs. When +25V is applied to the device for programming purposes, the diode becomes reverse-biased so that the 5V power supply is not affected. It is very important to connect this diode the right way round to avoid serious damage to the computer's power supply. The anode of the diode must be connected to the Atom's +5V supply. The cathode is usually marked by a thick painted ring on the diode body and should be connected to pin 21 and the programming switch.

After constructing the circuit you do not need the programmer card to prove that the program is working: with the card unplugged the program will copy

(continued on page 156)



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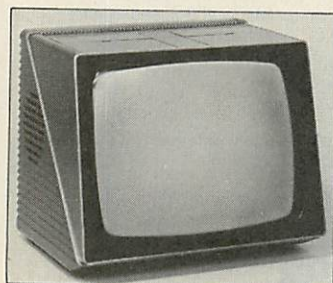
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#FF into each screen RAM location. You can check this by first clearing the mode 4 screen, then adding line 95

Running the EPROM copy routine will let you see the memory being filled which takes about four minutes. The verify routine reads the EPROM and compares it with the contents of the screen RAM. Any errors will be listed and a simple check-sum is computed by adding the decimal contents of each location together. See if the answer for the all-#FF case comes to $4,096 \times 255$.

Having satisfied yourself that the program works plug in the programmer card and set the Read/Program switch to Read, connection to +25V open-circuit. The diode has been connected correctly if you can measure 5V on pin 21 of the ZIF socket.

The light-emitting diode should flash during the Copy, Verify and Program modes. If it does not, it may be connected around the wrong way, so try reversing it. Next insert line 95 to watch the memory being loaded with the copy routine. If you short-circuit pin 20 to each data pin in turn on the ZIF socket, you can see from the bit pattern whether each data bit is being read. Do not try to fit an EPROM or connect 25V until you are satisfied that everything is in order.

Try reading an EPROM or ROM. You could unplug and read the floating-point ROM if you have a fully expanded Atoms. When you are ready to program a 2532 EPROM you can connect a 25V supply to the programmer card: four 6V transistor radio batteries connected in series are a simple way of obtaining it.

If you follow the program instructions to the letter, there should be no problem in programming your own EPROMs, and when you can program EPROMs, you will soon want to erase them. Unfortun-

Programmer card component list.

Component	Quantity	Comments
74LS374	2	eight-bit latch
BC108	1	transistor; any npn switcher will do)
1N914	1	diode (any 50V PIV diode suitable)
LED	1	any type
4,700ohm resistor	3	
470ohm resistor	1	may be omitted if diode LED not fitted
Single-pole switch	1	
64-way Eurocard DIN connectors (plug and socket)		
Verocard or similar prototyping card, about 5in. square		
24-pin zero-insertion-force socket		

UV lamps can be obtained from Watford Electronics, 33-35 Cardiff Road, Watford, Hertfordshire.

nately there is no simple method of doing so: intense ultraviolet radiation at a wavelength of 275.8nm. is required.

You can buy small fluorescent tubes which radiate at the correct frequency, but if you make your own eraser it is essential to mount the tube in a light-tight box to protect the eyes from harmful UV radiation. EPROMs to be erased should

be exposed for about 20 minutes about 3cm. from the tube. Commercial erasers usually have an automatic timer and safety cut-out switch to disconnect the light if the box is opened. Be careful with the erase timing since too much UV bombardment can shorten the number of program-erase cycles obtainable from the EPROM. ■

[illegible]

(continued on next page)

```

100 DIM A(10)
20 LET A=0
30 LET S=0
40 FOR B=1 TO 10
50 FOR E=1 TO 2
60 PRINT "FRAME "B" BALL "B" (E+156)
70 PRINT " "
80 LET Z=0
90 FOR C=1 TO 10
100 IF E=2 THEN GOTO 120
110 LET A(C)=52
120 IF A(C)=52 AND INT(RND*2)+1=1 THEN LET A(C)=23
130 IF A(C)=23 THEN LET Z=Z+1
140 NEXT C
150 PRINT "CHR$(A(1))" "CHR$(A(2))" "CHR$(A(3))" "CHR$(A(4))"
160 PRINT " " "CHR$(A(5))" "CHR$(A(6))" "CHR$(A(7))" "CHR$(A(8))"
170 PRINT " " "CHR$(A(9))" "CHR$(A(10))"
180 PRINT " "
190 PRINT "AT 15.0: SCORE THIS FRAME IS "Z
200 IF E=1 AND Z=10 THEN GOTO 350
210 IF Z>9 THEN LET Z=15
220 IF E=2 THEN LET S=S+Z

```

10-pin bowling

THIS PROGRAM by G. L. Stoneman of Wigan, Lancashire is a novel computer simulation of the popular bowling-alley game. The computer prints out the pins before each ball is bowled and automatically keeps your score.

There are 10 frames per game with two balls per frame. If you are lucky enough to make a strike — by knocking down all 10 pins with the first ball of a frame — you are awarded 30 points. Knocking down all 10 pins using both balls wins you 15 points. Otherwise each pin knocked down is worth one point. Pressing New-line rolls the next ball.

The pins still standing are represented by 0 and those that have been knocked down are shown as *. The program can be run in either Fast or Slow mode.

10-pin bowling

THIS PROGRAM by Roy Carnell of Kirkcaldy, Fife is designed for use on the 1K ZX-81. It will calculate the volume of a cylinder, sphere or cuboid and display the answer in cubic centimetres, litres and gallons. To use it input the measurements in centimetres of each dimension when asked for by the computer.

Hunt is a game for the 1K ZX-81 in which you are the hunter and the hunted. To score points you must guide your marker O to intercept the moving *, at the same time avoiding the X which gobbles up everything in its path.

The game ends when you have been "chomped" by the X. To move your marker use keys 5, 6, 7 and 8. Your O will move in the direction of the arrows on the keyboard.

Volume and Hunt



Volume.

```

5 REM "VOLUME"
10 PRINT "AT 8.0: CYLINDER PRESS 1", AT 10.0: "SPHERE PRESS 2", AT 12.0: "CUBOID PRESS 3"
15 INPUT N
20 CLS
25 IF N=3 THEN GOTO 40
30 PRINT "AT 8.12: RADIUS?"
35 INPUT R
37 IF N=2 THEN GOTO 100
40 PRINT "AT 8.12: HEIGHT?"
45 INPUT H
50 IF N=1 THEN GOTO 90
55 INPUT L
60 PRINT "AT 8.12: LENGTH?"
65 INPUT W
70 PRINT "AT 8.12: BREADTH?"
75 INPUT M
80 LET A = (H*L*M)
85 GOTO 105
90 LET A = (PI*R**2*H)
95 GOTO 105
100 LET A = (4/3*PI*R**3)
105 PRINT "AT 8.2: A", " "
110 PRINT "AT 10.2: A/1000", " "
115 PRINT "AT 12.2: A/1000/4.5461", " "
120 STOP
130 REM "HUNT"
140 LET T=0
150 LET C=15
160 LET D=15
170 PRINT "AT 7.11: SCORE "T
180 FOR A=10 TO 18
190 RAND
200 LET B=INT(RND*8)+1
210 PRINT "AT A,B: *", AT B,B: "X" AT B,B: " "
220 IF INKEY$ = "5" THEN LET C=C-1
230 IF INKEY$ = "6" THEN LET D=D+1
240 IF INKEY$ = "7" THEN LET D=D-1
250 IF INKEY$ = "8" THEN LET C=C+1
260 PRINT "AT D,C: "C"
270 IF A=D AND B=C THEN GOTO 190
280 IF B=D AND A=C THEN GOTO 220
290 NEXT A
300 GOTO 60
310 PRINT "AT D,C: "inverse space" AT D,C: " "
320 PRINT "AT D,C: "graphic A" AT D,C: " "
330 LET T = T+1
340 GOTO 50
350 PRINT "AT D,C: "CHOMPED", AT D,C: "7 spaces"
360 GOTO 220

```


Obstacle

THE GAME of Obstacle by Loll Holt of Worsley, Manchester, incorporates moving graphics into a 1K ZX-81. The object of the game is to move the asterisk as quickly as possible from the top left-hand corner of the screen to the opposite corner and back again, avoiding the blocks.

The asterisk is moved using the unshifted cursor-control keys. Once it has begun to move, both start and finish are marked by inverse asterisks. The time in seconds is displayed after each move, which begins as soon as the asterisk appears and only appears to end when you are not touching the keyboard.

Memory is obviously very tight, and an Out of Memory error will require you to restart the program. Use the Break key to stop the game.

Average players complete a game in 43 to 50 seconds. The record, so far, is 41.46 seconds.

Variable list

HERE is a machine-code routine which, when called, lists the names of the ZX-81's stored variables, writes Ian Stewart of Alva, Clackmannan. The routine works in both 1K and 16K, but since it uses 104 bytes of memory it is really much more useful with 16K machines than with unexpanded ZX-81s.

The routine is relocatable in memory and can be stored in a Rem statement perfectly safely, although if you store it there you must not try to bring the Rem line down with Edit. Perhaps the best place for it is at the top of the memory. To call the routine, type

IF USR XXXXX THEN

and then press Newline. The syntax looks odd, but it provides a safe way of running any machine-code program.

The output consists of the names of the variables, but not their values, separated by inverse spaces. For-Next control variables are identified by an asterisk, arrays by a < sign, and strings by the standard \$. These conventions can be changed by using different values in place of the ones in my program — they are underlined in the listing.

The routine should relieve all those who have typed in a Let command some

(continued from previous page)

```
230 PRINT AT 17,0;"SCORE SO FAR":S
240 INPUT U$
250 CLS
260 NEXT E
270 NEXT B
280 PRINT "SCORE FOR THAT GAME WAS":S
290 IF S<Y THEN GOTO 310
300 LET Y=S
310 PRINT "HIGHEST SCORE SO FAR":Y:AT 9,0;"PRESS N/L TO PLAY."
320 INPUT U$
330 CLS
340 GOTO 30
350 PRINT AT 7,3;"STRIKE"
360 LET E=2
370 LET S=S+15
380 GOTO 210
```

Obstacle.

```
5  RAND
10  FOR I = 1 TO 35
15  PRINT AT RND * 21, RND * 7; "graphic H"
20  NEXT I
25  LET L=0
30  LET C=0
35  POKE 16437, 99
40  POKE 16436, 99
45  PRINT AT L,C; "*"
50  PRINT AT 4,9; (25443 - PEEK 16436 - 256 * PEEK 16437)/50
55  IF INKEY$ = "" THEN GOTO 55
60  PRINT AT L,C; " "
65  PRINT AT 0,0; "inverse asterisk"; AT 21,7; "inverse asterisk"
70  LET M = L
75  LET D = C
80  LET L = L + (INKEY$ = "6") - (INKEY$ = "7")
85  LET L = L + (L<0) - (L>21)
90  LET C = C + (INKEY$ = "8") - (INKEY$ = "5")
95  LET C = C + (C<0) - (C>7)
100 PRINT AT L,C;
105 IF PEEK(PEEK 16398 + 256 * PEEK 16399) <> 128 THEN GOTO 45
110 LET L = M
115 LET C = D
120 GOTO 45
```

time ago, and then forgotten the variable's name. The listing is in decimal to speed entry. Note that it is to be entered reading down the first column, then down the next, and so on. It is 104 bytes long.

Superzap

FROM GEOFFREY HARMAN at Solihull, West Midlands come no less than four entertaining programs for the 1K ZX-81. Superzap is an invader game in which the object is to shoot down as many invaders as possible before the alien lands on Earth. The controls are:

0 for up
8 for down
1 for fire

Be careful not to press two keys at once.

Line 70 contains 26 minus signs, and line 80 contains 26 spaces. Line 150 is simply a delay between each Martian's appearance on the screen. The record score to date is 28.

Martian Invasion is similar to Superzap, but two aliens approach you at the same time. You have to run the program after being told your score. The controls are the same as in Superzap.

Circles allows you to draw circles of any size at any position on the screen. Adding the line

80 RUN

fills the screen with circles.

The first input asks how far across to draw the circle, and the second how many pixels up. The third defines the size, which cannot be greater than 10.8. The computer starts the drawing to the left of the circle, so this should be borne in mind when specifying the position.

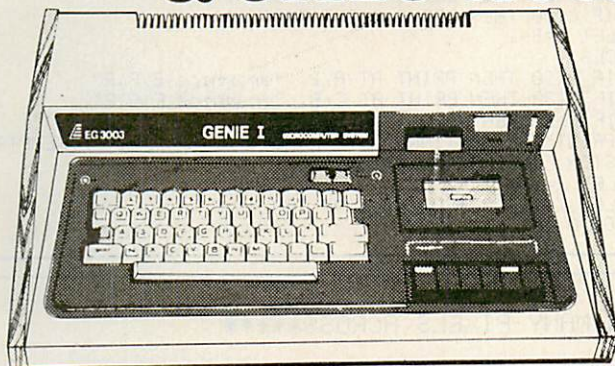
In Lem you have to land a lunar entry module from a height of 1,000 metres. Enter the thrust each time, and the computer calculates altitude, fuel remaining and speed. The program counts the number of turns you need to land. A total of under 20 turns is quite good. The game is over when your velocity reaches zero.

(continued on page 160)

Variable list.

42	127	203	64	215	127	13	35
16	40	111	215	17	40	12	24
64	10	40	17	18	249	13	165
126	203	64	6	0	214	32	214
254	119	24	0	25	128	2	32
128	40	6	25	24	24	62	14
200	12	203	24	200	224	19	1
71	203	111	212	214	14	215	24
62	111	40	214	128	0	35	232
128	40	36	192	215	214	94	214
215	76	24	215	35	96	35	160
120	24	21	62	126	215	86	24
203	21	214	23	203	62	25	248

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Superzap.

```

1 LET Z=0
2 PRINT, "PRESS 3 TO START"
4 IF INKEY$ <> "3" THEN GOTO 4
5 LET A=29
10 LET D=INT(RND*10+5)
20 LET X=10
40 CLS
45 PRINT AT D,A;"graphic E, graphic F, graphic R"
50 IF INKEY$="0" THEN LET X=X-1
55 IF INKEY$="8" THEN LET X=X+1
60 PRINT AT X,3;"graphic H"
65 IF INKEY$ <> "1" THEN GOTO 105
70 PRINT AT X,4;"-----"
80 PRINT AT X,4;" "
85 IF X=D THEN GOTO 150
105 LET A=A-1
110 LET D=D+INT(RND*3-1)
115 IF A=2 THEN GOTO 170
130 GOTO 40
150 LET C=SIN 45*SIN56*SQR TAN 54.8
152 CLS
155 LET Z=Z+1
160 GOTO 5
170 PRINT AT 15,2;"YOU ZAPPED ";Z;" ALIENS"
200 RUN

```

Martian Invasion.

```

1 LET Z=0
10 LET A=INT(RND*10+5)
20 LET C=INT(RND*15+3)
30 LET B=28
40 LET X=10
60 IF INKEY$="0" THEN LET X=X-1
70 IF INKEY$="8" THEN LET X=X+1
75 PRINT AT X,3;"inverse space"
80 IF INKEY$ <> "1" THEN GOTO 130
90 PRINT AT X,4;"twenty six minus signs"
100 IF X=A THEN LET A=30
110 IF X=C THEN LET C=30
130 IF A=30 AND C=30 THEN GOTO 300
140 IF A<30 THEN LET A=A+INT(RND*3-1)
150 IF C<30 THEN LET C=C+INT(RND*3-1)
170 LET B=B-1
180 CLS
190 IF A<30 THEN PRINT AT A,B;"graphics E,F,R"
200 IF C<30 THEN PRINT AT C,B;"graphics E,G,R"
210 IF B>2 THEN GOTO 50
230 PRINT"THE MARTIANS HAVE LANDED AFTER ";Z;" ATTEMPTS"
240 STOP
300 LET Z=Z+1
310 LET K=SIN 23*COS 65 *SQR TAN 45
320 GOTO 10

```

(continued from page 158)

The thrust acts as a brake and reduces speed but slows down descent. The rockets can develop up to 50,000 pounds of thrust. The program also takes into account gravitational force, and you should watch the fuel gauge.

Effective programming

A J PEGG of Abergavenny, Gwent has some useful hints on making programs for the ZX-81 more efficient. When you want to print blank lines on the screen it is often possible to simply add extra commas to the end of the previous Print statement. For example,

```
PRINT "TITLE",,
```

will print a blank line after title.

Every number written in a Basic program, except line numbers, takes up six bytes plus the number of figures in the number. If the same number occurs three times or more in a program it therefore saves space if the number is assigned to a variable for use throughout the program.

A subroutine should be used when a set of instructions or single instruction is used more than once. There is a net saving of space if the repeated routine takes up more than 14 bytes of memory.

When converting ZX-80 Basic for the

Data commands — sample program.

```

100 FOR A = 1 TO 8
110 GOSUB 50
120 PRINT A$; "(SPACE)";
130 IF A = 2 OR A = 5
    THEN PRINT
140 NEXT A

```

Data commands routine

```

1 LET ZZ=16540
2 GOTO 100
5 REM WORDS OR PHRASES, SHOULD, BE STORED,
10 REM IN REM, STATEMENTS, ANYWHERE, IN THE, PROGRAM,
50 IF PEEK (ZZ+1)<28 OR PEEK (ZZ+1)>63 THEN GOSUB 80
55 LET A$=""
60 LET ZZ = ZZ+1
65 IF PEEK ZZ = 26 THEN RETURN
70 LET A$ = A$ + CHR$ PEEK ZZ
75 GOTO 60
80 LET ZZ = ZZ + 1
85 IF PEEK ZZ = 234 THEN RETURN
90 GOTO 80
100 START OF MAIN PROGRAM.

```

Circles.

```

5 REM *****HOW MANY PIXELS ACROSS*****
10 INPUT X
15 REM *****HOW MANY PIXELS UP*****
20 INPUT Y
25 REM *****HOW LARGE TO MAKE CIRCLE*****
30 INPUT T
40 IF T>10.8 THEN GOTO 30
50 FOR N=1 TO 13 STEP 0.1
60 PLOT X+(2*(T-T*COS(N/6*PI))),Y+(2*(T+T*SIN(N/6*PI)))
70 NEXT N

```

ZX-81, remember that RND (N) produces an integer random number in the range 0 to N. The equivalent statement for the ZX-81 is

```
INT(RND*(N+1))
```

The ZX-80 function TL\$(A\$) has the effect of placing the left-hand characters of A\$ in the string required, and removing it from A\$. For example

```
LET B$ = TL$(A$)
```

would become,

```
LET B$(TO 1)
LET A$ = A$(2 TO )
```

in ZX-81 code.

Data commands

THIS PROGRAM provides the equivalent of Data, Read and Restore commands for the ZX-81, writes Andrew Rushton of Wakefield, West Yorkshire.

The command Gosub 50 puts the next word from the Rem statements into A\$. Words can be placed in Rem statements anywhere in the program, starting from line 3, but operation of the program is faster if the Rems are between lines 3 and 50. Words, letters, numbers and phrases should be separated by commas, and the

Lem.

```

5 LET V=100
10 LET A=1000
20 LET M=2500
30 LET S=1
40 LET U=0
50 PRINT AT 5,0;S
60 PRINT AT 6,0;"ALTITUDE",A;"
70 PRINT AT 8,0;"SPEED",V
80 PRINT AT 10,0;"FUEL",M-2000-U
90 INPUT F
100 PRINT AT 12,0;"THRUST",F;"
110 IF F>50000 THEN GOTO 90
115 LET S=S+1
120 LET U=F/50000*50
130 LET M=M-U
140 LET V=V-(F/M)-2)
150 LET A=A-V
160 IF A<0 AND V<5 THEN GOTO 300
170 IF M<2000 OR A<0 THEN GOTO 350
180 GOTO 650
300 PRINT AT 18,3;"WELL DONE"
310 STOP
350 PRINT AT 18,3;"YOU CRASHED"

```

last character in each Rem statement should also be a comma.

The example program should incorporate the Rem statements given in the main program. The statement

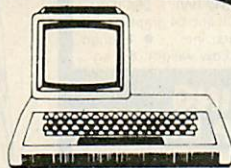
```
LET ZZ = 16540
```

anywhere in the program will take you back to the first words in the Rem statement.

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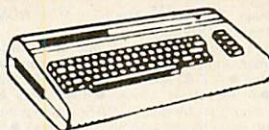
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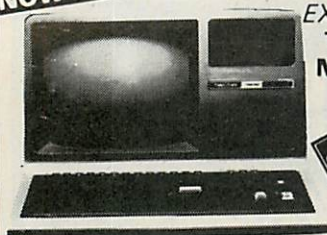
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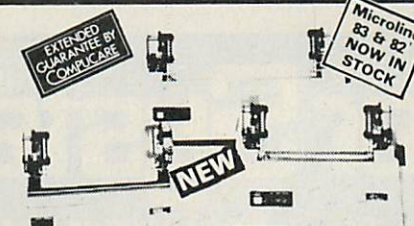
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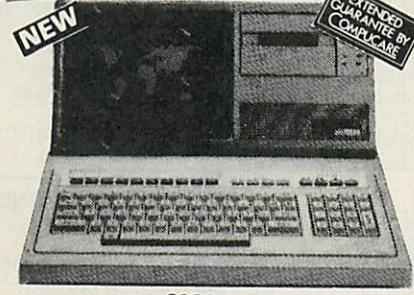


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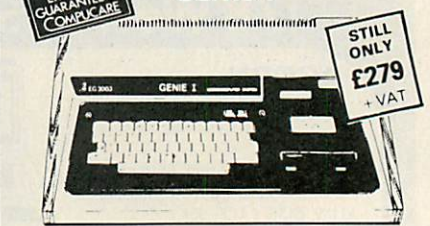
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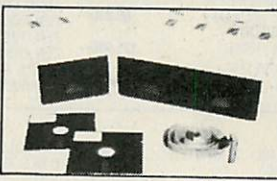
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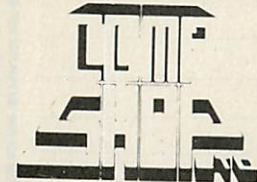
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Data Structures using Pascal

By A M Tenenbaum, and M J Augenstein. Hardback £10.95. Prentice-Hall. ISBN 0 13 196501 8.

WHETHER THIS BOOK is mainly about data structures or the limitations of Pascal is not clear, but it is certain that in parts the book is seriously wrong. The authors claim on page 1 that "A computer is a machine that manipulates information", whereas most of us think that a computer manipulates electrical impulses according to set rules. It is the users who give meanings to these impulses, to enable us to derive information from the bits, bytes and words.

"Information" requires us to give a meaning to patterns. To confuse the notion of information with the presence of patterns might explain why the authors make the absurd assertion on page 6: "Thus we see that information itself has no meaning", a statement, which becomes understandable as "Thus we see that patterning in itself has no meaning".

When they start with more "complex" structures, the authors use Pascal to produce illustrative procedures. By using it, many of Pascal's disadvantages as a proper language appear. For example, on page 73 they discuss how to implement a stack for real numbers: "this can be done simply in Pascal by introducing a new type stackitem and defining a stack in terms of this new type". One defines a set of routines using stackitem and, for an integer stack, one declares

TYPE stackitem = integer

The same routines can be used to manipulate a stack of reals by changing the Type declaration, but this means that one cannot have both real and integer stacks at the same time. In Algol 68 this would not be a problem, for the routines to perform stack manipulation could be set up as operators, and the same named operator could be used for different types of stack. The lack of a proper block structure in Pascal leads to further complications, as does the static allocation of storage.

The chapter on stacks is followed by one on Recursion, and the chapter is as full of imprecisions as ever. I was pleased to read on page 100: "Let us examine a less familiar example" but then I read "The Fibonacci sequence..." The Fibonacci sequence is one of the most common of the point-less examples used to illustrate recursion.

I decided that Tenenbaum and Augenstein were sledgehammer users. Unfortunately they are not the only sledgehammer users trying to sell computing textbooks. Though this book is no worse than many I have seen, I cannot recommend it. It conforms to most of my prejudices concerning certain forms of computer science education — as Dijkstra has said, sledgehammers to crack eggs.

Boris Allan

Pet Interfacing

By James M Downey and Steven M Rogers. Howard W Sams and Co. £11.85.

THERE HAS ALREADY been much written about the Pet and its use as a controller for other hardware, but much of it has been in magazine articles. This book sets out to provide the essentials of Pet interfacing in one place, and to provide

ideas for the use of the various interface connectors provided by the Pet micro-computer.

The first two chapters provide an introduction to the Pet hardware and building instructions for a breadboard to give easy access to the user-port signals. The circuit is used as the basis for all the user-port projects in the book. Included in this chapter is the description of a simple logic probe which eliminates the need for expensive test equipment. The third chapter is concerned with applications using the user port and includes serial input and output as well as the conversion of analogue to digital signals and vice versa.

The next three chapters describe in a similar way the experiments and projects using the memory port. As with the user port there are many useful circuits such as address decoders and more advanced interfacing techniques. Chapter 7 provides a 'miscellany of interfacing techniques including the control of mains and other high-power devices. The final chapter covers the IEEE port in detail and includes circuits for the user of the Pet as both an IEEE bus controller and as a listener/talker. Appendices provide the flowcharts and assembler-program listings

required to implement such facilities.

The book uses a clear step-by-step approach throughout and little is taken for granted. In addition there is comprehensive software support by the provision of routines for inclusion in user programs. This book illustrates why the Pet has been adopted by many sophisticated users for laboratory and other control purposes, the addition of a few pounds worth of components turns it into a very competitively priced controller.

Conclusions

● A practical book for the experimenter or a useful reference for anyone using the Pet as a controller.

● Although comprehensive, this book is accessible to anyone who has the slightest knowledge of or interest in electronics. The only knowledge required is how to handle sensitive modern devices and how to solder a connection.

● Except for the proprietary circuit board used for the user-port circuits, for which there are suitable alternatives, all the components used are readily available.

● An essential book for Pet enthusiasts who are interested in hooking up their computers to other equipment.

Martin Wilson

Writing Interactive Compilers and Interpreters

By P J Brown. Paperback 265 pages, £5.95. John Wiley & Sons. ISBN 0 471 10072 2.

THE TITLE is perhaps the worst part of this book. It sounds as if it might describe some particularly dry and dire product of the computer science schools. Instead it is a lively, interesting and practical guide to the hinterland of really tough computing.

Professor Brown, who teaches at the Computing Laboratory of the University of Kent at Canterbury, chose this topic not so much because more than a handful of his readers would ever want to write an interactive compiler, as because if you can write one you can do almost anything. Hidden inside your machine's

Basic which you take for granted every day is some of the cleverest software you will ever use. This book not only explains why it is clever, it also makes the reader understand why it may not be as clever as it could be and what might be done about it.

The author has evidently suffered, and his book is written from a deeply realistic standpoint. For instance, in discussing coding errors and what an interpreter should do about them, he says: "We have emphasised in this book that the error case is the normal case. Thus a parser (the bit of an interpreter that 'reads' program lines) should be regarded as a tool for pointing out syntactic errors in users' programs. Once in a while a user will produce a completely correct program, and will make use of a parser's secondary function — its use

in helping to create the internal program".

Anyone who writes applications software should have this stencilled inside his hat, because it applies to any program. Errors are normal, accurate inputs the exception: programmers ought to realise which is more important.

If Professor Brown earns, as he ought, the gratitude of end users he may well find himself drummed out of the obfuscating fraternity of computer scientists. For instance: "If a user manual looks like a mathematical thesis, most people will never look at it. Many languages have suffered from being presented to the world in a form the world does not understand. It is important to have a formal notation that is both precise and easy for ordinary people to read". These are dangerous words.

Peter Laurie

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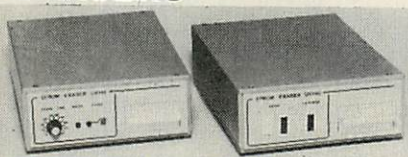
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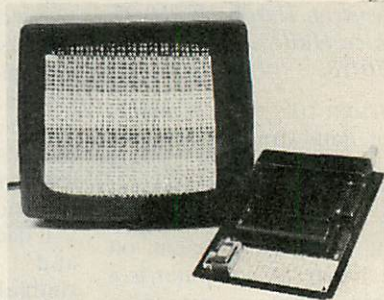
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Word search

by Douglas Nunn

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I P Y B B G C A M C T X O I O
P R P I H M R S S H U W N V N
M O P C G T P I A I P I U E I
O C O C R O R C C P M N D M T
C E L O A L I O A W O O V A O
M S F B P I N Q F L C I S R R
A S Y O H P T F H E O I J F O
R O R L I G E A N A L G C N B
G R O E C K R I D I S K L I O
O N M T P E H D C I G O L A O
R J E M I C R O S Y S T E M T
P A M D A B N E T T E S S A C
O K P M E T Y B O L I K M L C
    
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Word list

MICRO
COMPUTER
MAINFRAME
SILICON
CHIP
WORD
PROCESSOR

KILOBYTE
ROM
RAM
LOGIC
PROGRAM
HARDWARE
VDU
GRAPHIC

MONITOR
FLOPPY
DISK
CASSETTE
MACHINE CODE
FORTRAN
PASCAL
BASIC

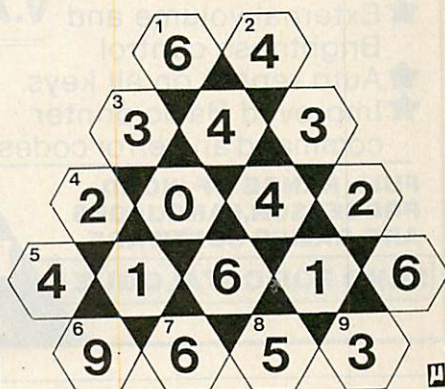
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COMPILE

WHEN OUT DIGGING on the island of Skye, a team of anthropologists found this rather strange and apparently random matrix of letters. One of the team, a keen computer user and academic, discovered that among the letters it was possible to find a whole list of words relating to the ultra-modern world of microcomputers.

If you wish to try and recapture the excitement of that discovery then hunt through the letters and try to find those words contained in the word list. Once you have found a word, ring it and tick it on the list.

Solution to April puzzle



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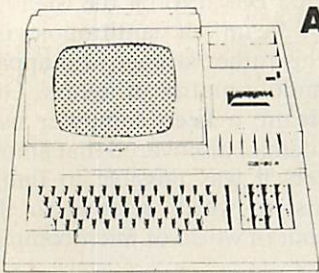
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In the early 1960s there were widespread fears that computers were about to take over. Boris Allan takes a close look at today's predictions of omniscient expert systems, in the light of what happened to their predecessors.

IT IS 1982 and information technology is really with us, yet some of the futurology produced today is as out of touch as it was 20 years ago.

In 1962 in *Computers and the World of the Future* C P Snow expressed misgivings that a new elite might be formed if only those who are concerned with the computers are going to be knowledgeable about decisions.

So far such elitism has not taken hold, and Snow's worst fears have been unfounded. Snow later argues: "... if we let the individual human judgement go by default, if we give all the power of decision to more and more esoteric groups, then both the moral and intellectual life will wither and die".

Human paradigm

E E Morison, then Professor of Industrial History at the Massachusetts Institute of Technology, suggested a test of expert systems. The computer would reconstruct a series of historical situations of increasing complexity in which men have acted most successfully.

Morison expected several benefits from this exercise. First, people would have to learn some history. Secondly, we could evaluate the machine by comparing the computer results with actualities; and, finally, the machine would become not so much a problem solver as a learning machine.

In 1962 learning machines were very fashionable. Morison hoped not only that this computer would force us to ask proper questions, but might help us sort out the things that can be thought from the things that can only be felt. In all of Morison's argument there is the assumption that the human is correct and that if the computer is to do what humans have done, it must be judged by comparison with humans.

Marvin Minsky was less impressed with humanity — especially historians — and more impressed with computers. Minsky suggested giving the computer a precise area of history about which not everything is generally known, and then having a group of professional historians study the facts and predict the outcome. He thought that historians had meticulously avoided any such experiments.

Morison agreed, saying that he had made the suggestion to see what other historians might say, and implying that

What chance 1984?

neither humans nor computers could claim perfection. In the same book N Beecher noted that the training of a person in values took from 21 to 50 years — depending on the society — before that person was judged worthy to make a real decision.

In the final chapter, J R Pierce of Bell Telephone research observed that the superpower confrontation in the early sixties made it urgent to teach more people Russian. He was told, however, by a U.S. Air Force officer that the training would take too long and the Air Force could not wait.

With typical military thoroughness, six projects on the machine translation of languages had been initiated by the Air Force, four by the National Science Foundation, two by the Army, and one by the Navy. There is no evidence that any of these projects has replaced the need for Russian/English translators.

In 1962 Minsky bet that the IBM-704, if properly programmed, could read human script faster than a human. Pierce's comment on Minsky's bet has proved justified:

These are nice bets, but how long do we have to wait? Will I live so long? I do not doubt that it will read script faster, if you do not care how well it reads it. There is a wonderful tendency to talk about things that lie in the future and that you cannot prove will not happen. This is good clean fun ...

Failure follows fame

No wonder that Dreyfus claimed that, whereas fame in many fields only came when success was achieved, "artificial intelligence seems to be operating instead on the principle of fame until failure".

This all sets the scene for a recent piece of futurology, which makes many claims for the power of expert systems, and also seems designed to help produce a new elite.

Snow's comments about the political dimension are especially relevant because Philip Virgo's *Learning for Change* has been produced by the Conservative Party's Bow Group to coincide with Information Technology Year. The report set out to diagnose what is wrong with Britain, British education, British industry, and then suggests how we can be rescued from decline. The author is chairman of the Conservative Computer

(continued on next page)

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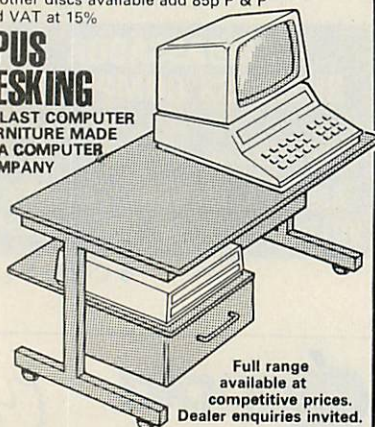
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(continued from previous page)

Forum and claims to have worked in the computer industry. On the first page we read, "Fundamental changes to the education system are necessary. Information technology makes these possible at economic cost".

The report consists of six sides of A4 priced at £2. Later we find that he really means computer-assisted learning, CAL not IT, and that he imagines "at the end of a CAL packaged course, each student has reached the same level of understanding, some more quickly than others".

Yet we all know that when all the pupils in a class can recite their tables, only a few can understand what they really mean. Understanding requires more than successfully reaching the end of a task. Real ideas, such as the concept of number, are notoriously difficult to learn by mechanical methods such as tables.

Leonardo da Vinci pointed out that there are ideas which require for their exposition experience rather than the words of others, and in the context of learning this means giving as many different experiences as possible — and not principally a CAL experience. I do not know how a machine can teach morality, or even the meaning of entrepreneurship. The author's belief that "two years and a million or so pounds to assemble quality packages which can be mass-produced on discs or transmitted over the air or down telephone lines, is a lot faster and cheaper than retraining several thousand teachers over a decade or two", has more than a passing similarity to the U.S. Air Force view about Russian/English translation, which has yet to be successfully mechanised. Why should the use of CAL be any more successful? Where are the experts to design the systems?

Logical skills

At one point the author states the unthinkable:

... the complex diagnoses that elevate the Harley Street consultant above the local general practitioner, can already be done faster and more accurately by computer.

It would be interesting to know the whereabouts of this marvellous computer, and then see it in action. The report also thinks that lawyers, tax inspectors and accountants can also be easily replaced by computers, because these groups only offer "book-learning and machine-like logical skills". He forgets that judgement is an important part of all these occupations. I would rather trust my tax affairs to an accountant, or myself, than to a computer.

Virgo would have children

"... associate education with reward and relevance. Forget the sport field, swimming pool and minibus ... If you do not feed the mind and teach it how to earn a living all you've got is a physically fit, unemployable delinquent".

He has the same instrumental

approach to higher education, wanting an increased emphasis on training of future employees and applied research to the detriment of academic research and the apprenticeship of future academics.

Virgo certainly would not approve of a scientist who was only playing with mathematical symbolisms because he found it fun — yet this is how Albert Einstein laid the way for nuclear power and the nuclear arms race. In the early 20th century no-one realised the potential consequences of his discovery in theoretical physics.

Trendy priorities

Virgo is forever accentuating the need to follow trends and fashions: priority should be given to retraining taxpayers or training their children for jobs in known demand.

In the field of computer software, for instance, Britain is a world leader, but the ideas in *Learning for Change* would have a deleterious effect on just the quality of those very successful ideas.

A further confusion is to take the impressive speed at which technology is changing, and assume that ideas change at the same speed, or that breakthroughs in knowledge are just around the corner. In 1962 there was argument about how long it would be before a computer became World Chess Champion; 20 years later we are still waiting.

The impressive developments in computing since 1962 have been mainly in the hardware. At present CAL is primitive and mainly used in technical areas, so to assume that in one or two years we will be able to teach languages by CAL is to fly in the face of reality.

To talk glibly, as many workers in AI now do, of the up-coming expert systems — especially an expert system to replace a Harley Street consultant — is very reminiscent of the arguments in 1962. How about an expert system to produce translations?

Once the expert system was set up, a few experts and analysts would still be needed to correct faults in the system, and this elite would make sure that their children were taught expert knowledge. For the rest of the population Virgo suggests that too much education is a dangerous thing

Too high a qualification is really a disqualification for a contented, competent employee. All they could expect would be spoon-fed low-grade pap, which is what CAL is best suited to assure.

The ideas contained in *Learning for Change* worry me, but, do not frighten me, because I know that our expert systems are little more expert than they ever were, or are likely to be for a long time.

References

Computers and the World of the Future edited by Martin Greenberger, MIT Press, 1962.
Learning for Change by Philip Virgo, Bow Publications, 1981.

BUYERS' GUIDE

Printers

The Peripherals Buyers' Guide is a survey of printers suitable for small computers. We have excluded any system which costs significantly more than £2,000. The printers are listed in alphabetical order. The addresses of the main suppliers are listed at the end of the guide.

Printers may be divided into several categories. The highest-quality printing is produced by the daisywheel-type which creates text in various type-faces, according to the wheel used. The quality ranges from excellent typing to rather poor book printing and generally there is a proportional-spacing facility. Those machines tend to be expensive and slow. Daisywheels can be either plastic — inexpensive, but must be replaced often — or metal — expensive but durable.

For faster printing, you must turn to dot-matrix machines. The print quality tends to be poor and the machines noisy. Older machines use a 7-by-5 matrix which puts the descenders of letters such as 'y' above the line. That makes bulk text difficult to read. Better printers use a matrix nine dots deep to give true descenders. Recently, several firms have produced dot-matrix printers which give an approximation to typewriter printing and proportional spacing. They are less expensive than daisywheel machines, work faster and could well be used for correspondence-quality work.

Some dot-matrix printers employ sensitised paper to produce printing by more direct electrical effects. They are often quiet and fast, but the paper can be expensive, unpleasant to handle and hard to obtain.

The trend is to build more processing power into printers. That means they offer increasingly varied features, so it is hard to categorise them precisely.

A printer has to be connected to the computer by a cable and a more or less standard interface. The normal interfaces are the Centronics parallel, RS232 serial port — also known as the V-24 — and 20mA current loop. IEEE is a parallel interface used by Pet; 'cpl' means characters per line, 'cps' means printing speed in characters per second. Allow five characters to the word.

The more intelligent printer prints as its head moves in both directions across the paper — bi-directional printing. Still more intelligent ones end the head movement at the ends of short lines. These two features can more than treble the working speed.

Printers use two types of paper: plain paper fed — like a



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typewriter — pinch- and pin- or sprocket- or tractor-fed with holes along the margins. That paper can be supplied fan-folded or in rolls.

Pinch feeding is more expensive but is convenient for letters. Only a few machines will accept both pinch- and pin-fed paper. It is possible to obtain headed letter paper bonded lightly on to pin-fed, fan-folded computer paper for word processors.

Some printers allow direct control of the print-head to give graphics. KSR means keyboard, send and receive, ASR means automatic send and receive, RO means receive only. KSR machines can be used as electric typewriters in local mode.

Comb or line printers have a whole line's worth of dot hammers so they can print a line of text at a time. They tend to be very expensive and very noisy but produce an enormous quantity of work.

ACCESS DATA COMMUNICATIONS

ADC 1251

Matrix printer, continuous paper, £13 per box, 80 or 132 cpl, 125 cps, 7x9 matrix. RS232, Centronics and IEEE interfaces.

£560

ADC 2401

9x9 dot-matrix printer, continuous paper, 136 cpl, 240 cps, RS232, Centronics and IEEE interfaces. Available from Access Data Communications.

£1,350

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DP-660

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DP-750A

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RO & KSR

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DATA GENERAL CORPORATION

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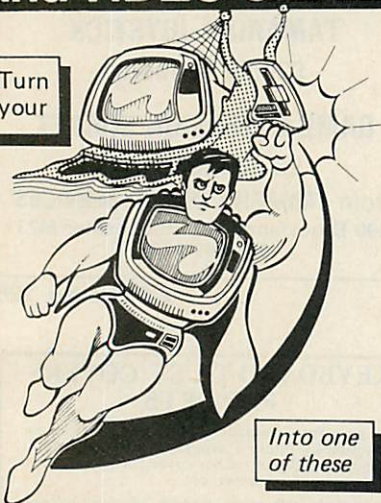
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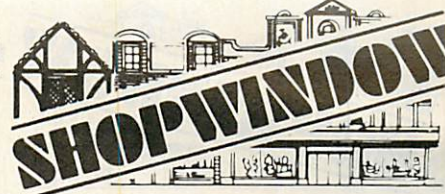
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Stalingrad was a turning point in the war against fascism. This game from *The War Machine* gives you a chance to find out how close the German army came to conquering Russia. You are in General Von Paulus's shoes, and the computer in Marshall Zhukov's.

EASTERN FRONT



EASTERN FRONT is written in machine code to run in 16K memory on the Atari 800 or 400. It is a simulation of Hitler's Operation Barbarossa in 1941, and runs from June 1941 to March 1942 in weekly turns. You play the Germans while the computer controls the Russians.

When the program is loaded a map of Russia appears, taking up two-thirds of the screen. The rest is occupied by the date of the action and two information panels. The map terrain includes rivers, mountains, swamp, forest and towns. The base colour of the map changes with the seasons, from brown in summer to grey in autumn and white in winter. The rivers change colour if they are frozen.

Screen information

On top of the map is a large hollowed-out square cursor which is controlled by the ubiquitous Atari joystick. If it is moved to the edge of the screen the map scrolls smoothly in the direction of cursor movement. The map stretches across an area of 10 screens.

Units are shown on the map as squares with different notations inside, depending on whether they are infantry or armour. When the cursor is positioned over the unit marker and the red trigger button is pressed, the unit designation, muster and strength are shown in the information panel at the bottom of the screen. Simultaneously with this an Iron Cross appears over the unit marker and this is the key to movement.

With the trigger pressed to show the cross, each movement of the joystick, up, down or sideways, will move the cross one step in that direction. The computer allows you to take eight steps. Releasing

the joystick will make a green arrow emanate from the unit to the cross to show the path of movement. This is a necessary feature as traffic jams of units can quite easily build up and slow down your unit's progress.

The arrow can be used to check the possible build-up of jams by positioning the cursor and pushing the trigger. The arrow and the unit's cross are then displayed to show the unit's movement.

With the moves sorted out, pressing the start button at the side of the Atari's keyboard will start the computer resolving combat, and moving units. After each turn a number between 0 and 255 appears on the information panel to tell you how well you are doing. If you are a beginner you can press the option key on the keyboard and the muster of German units is increased.

The game plays superbly. All the normal war-game rules are in force, including zones of control, logistics, terrain and combat. Although the computer does all the work resolving combat and movement, it is possible to see how your units

are doing on the screen. Combat is shown by the aggressors flashing on and off, and by the sound of machine-gun fire. Movement is shown as if it were a normal map board.

The tactics that have to be used are similar to those in the real battle. The Germans must use their tanks to break the line and speed towards Moscow and Stalingrad, while using the infantry as support and for mopping-up operations. When the Russian counter-offensive starts you feel like Canute trying to stem the tide.

Stalingrad crucial

The Germans must not spend too much time finishing off any Russian units behind their lines. It is better to stop them with one unit and starve them out through lack of supply.

To score highly Moscow and Stalingrad must be taken and held, and the Russians pushed as far east as possible. The computer will be planning its own moves while you are inputting yours. It does this by a system known as multi-tasking. It starts with a basic move and gradually refines it.

You can forget about rushing your move; the computer is fast, and will not be caught out by a rapid response from the player. The computer plays an extremely good game and after two months of play I can now score 50 points a game.

According to the excellent manual supplied with the game this rates as good. Apparently it is possible to achieve over 200 points — I must try harder.

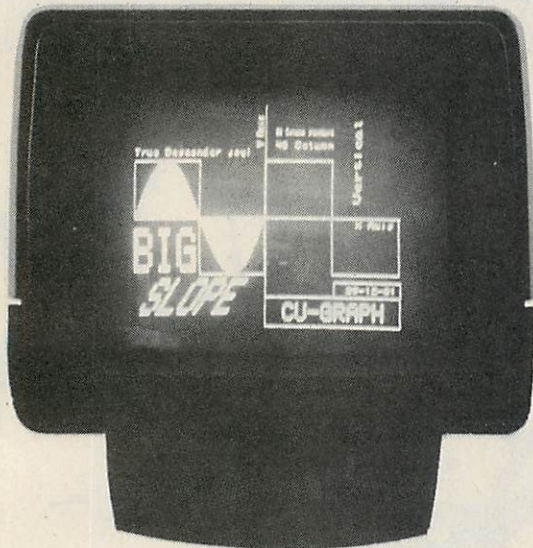
The War Machine is published monthly by Emjay, 17 Langbank Ave, Rise Park, Nottingham, NG5 5BU. £1.25 an issue, £13 for an annual subscription, postage and packing included.

Conclusions

- The computer will recognise weak spots, danger, and the use of differing terrain.
- It does not react to the player's strategy, but takes every turn as it sees it.
- A remarkable feat to have fitted so much into 16K.

Ratings:	
Physical quality	Good
Perceived complexity	Fair
Subject complexity	High
Realism	Good
Play balance	Demanding
Overall	Very good

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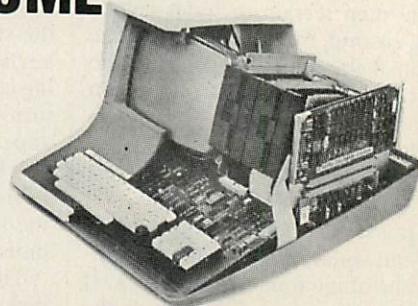
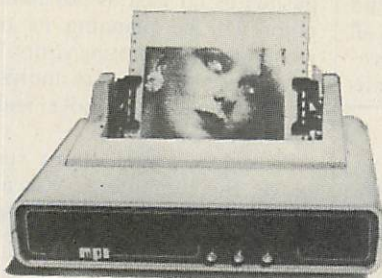
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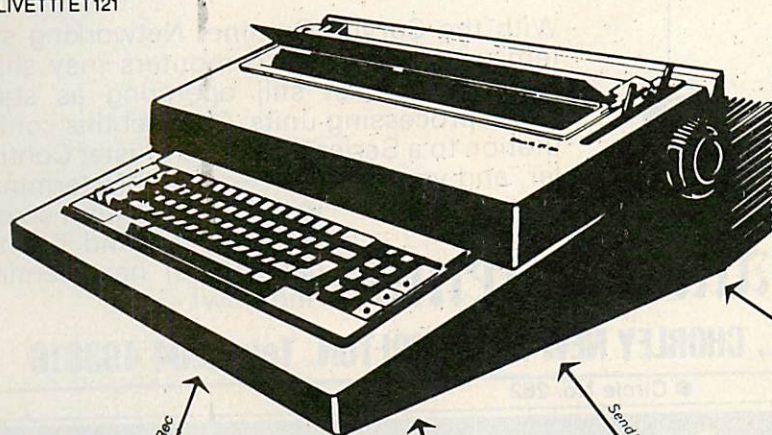
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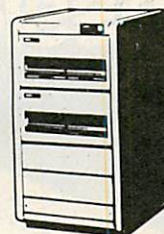
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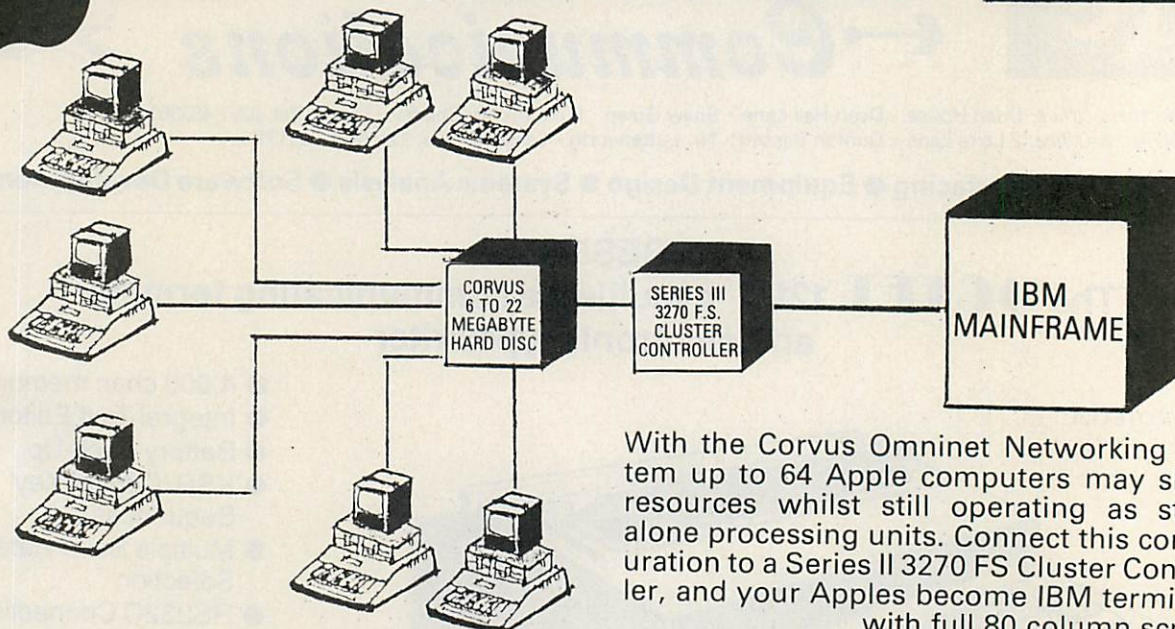
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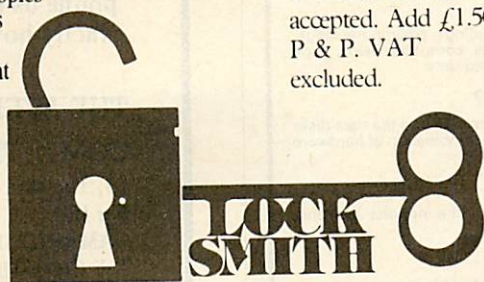
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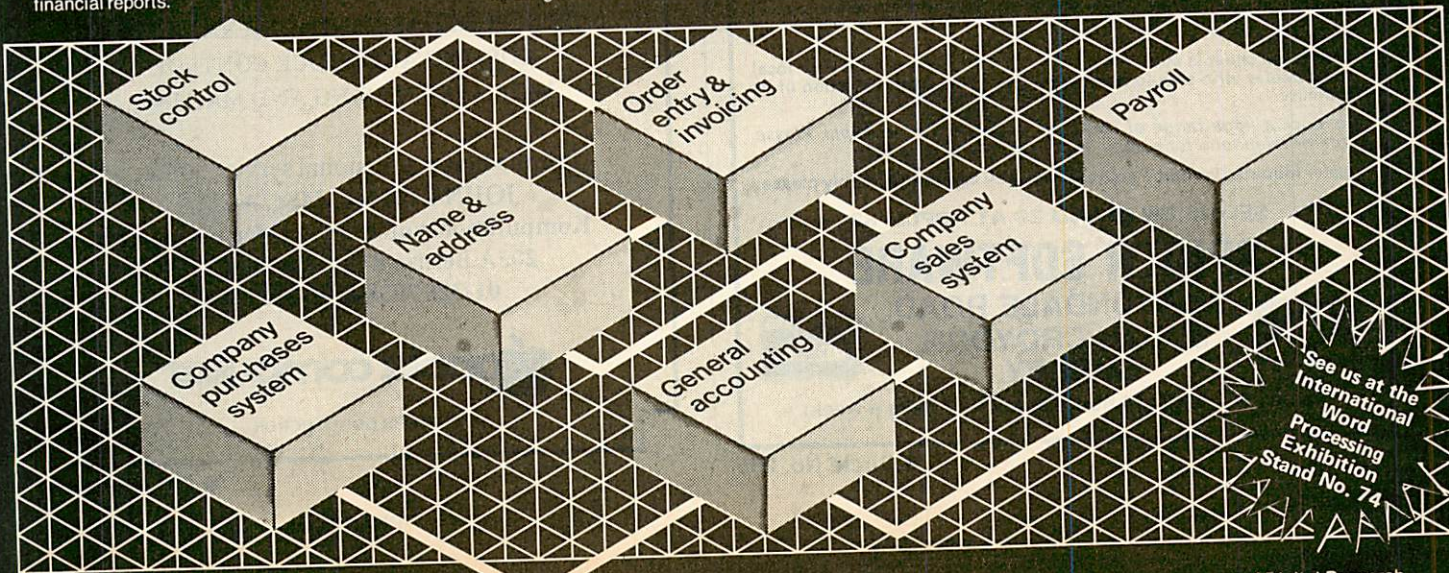
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How long will it take to find a record?

A powerful advanced IRAM (Indexed Random Access Method) is utilised for major record retrieval purposes giving an access speed of either instant recall or within 3 seconds. Any field (or combinations thereof) with multiple search criteria will either give instant recall or will take a maximum of 23 seconds. On the SYMBfile hard disk everything is at least 7 times faster.

How long will it take to sort a disk full of information?

All sorting is done on an index. If the sort is on the primary index it will take 0.2 seconds regardless of the number of records. To sort out any field which is not indexed involves first creating an index for that field which is then sorted. The time taken depends on the record size (generally less than 3 minutes). Any index can be saved for later use or made into a primary index. Sorting a disk need not involve creating a sorted version of the database.

How many disk drives do I need?

ACCESS will ideally run on 2 drives. However, it will support a single drive system and a version is available for the SyMBfile 5 megabyte hard drive.

How about report formats?

Reports are user-configured and can contain report headings, column headings, column sub-totals, brought forward totals, grand totals, computed fields, page numbering etc. Reports can be on selected and/or sorted data.

What if the dog chews my program disk?

We provide copy routines for backing-up of the program disk and the data disks as many times as you require. The ACCESS system is a combination of hardware and software.

Is the program menu-driven?

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How is the data stored?

ACCESS creates and uses its own data disks. However, facilities are provided to enable you to produce standard DOS 3.3 text files in either sequential or random access format using any sorted or selected fields. Because of ACCESS's own data storage techniques a very large database may require more than one disk to store the text file(s) produced.

How easy is it to create records and edit them?

ACCESS has a powerful word processor style screen editor enabling insertion and deletion of characters, etc., full cursor control across fields and pages of a record. A maximum of 40 screen pages are available. Password protected fields are supported as are computed on-screen fields.

What if I delete a record by mistake?

ACCESS only marks a record as deleted. Facilities are given to either "un-delete" deleted records or purge deleted records from the database.

My current database takes ages for me to add and save records because it needs to re-structure the entire file to keep the "primary key" in alphabetical order. Will this happen with ACCESS?

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What hardware do I need?

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Why should I buy ACCESS and how much is it?

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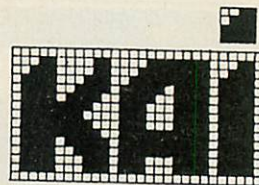
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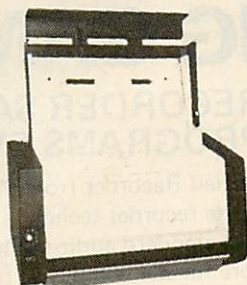


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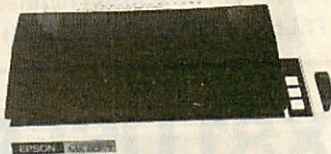
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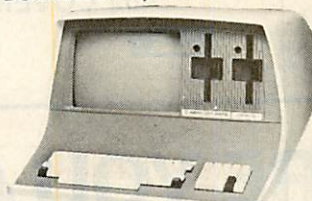
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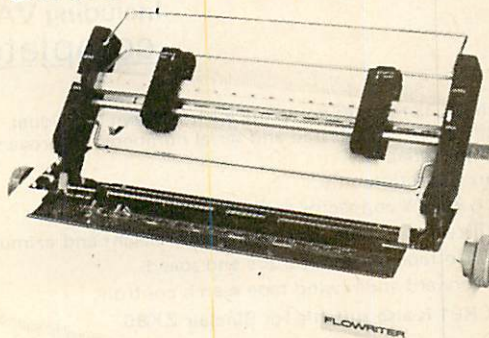
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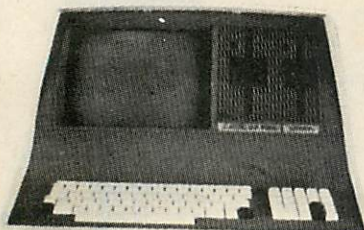
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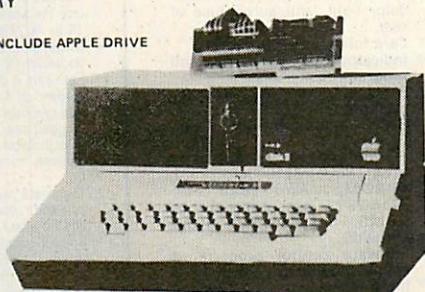
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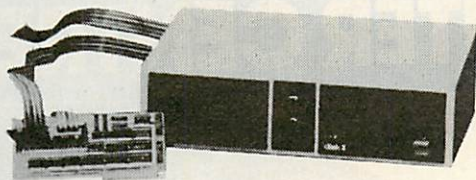
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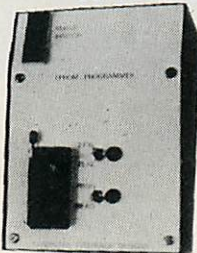
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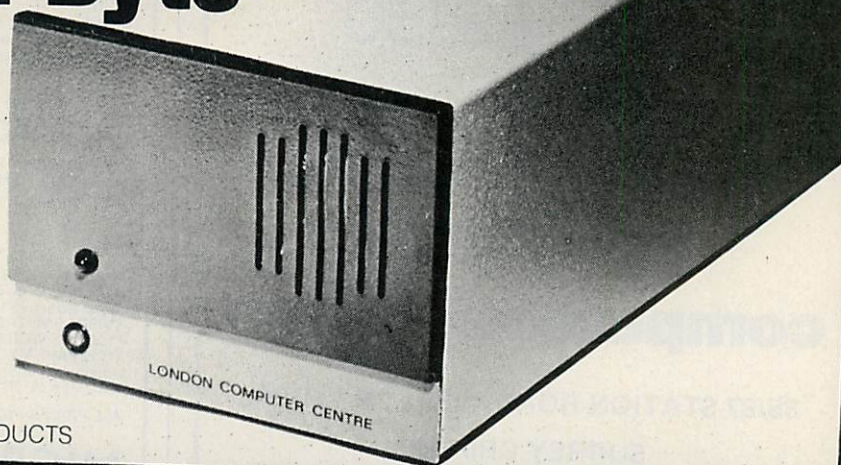
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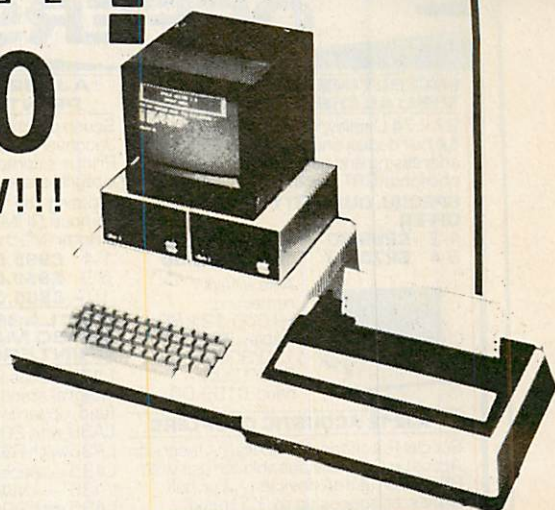
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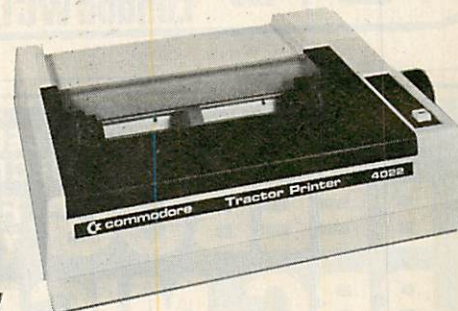
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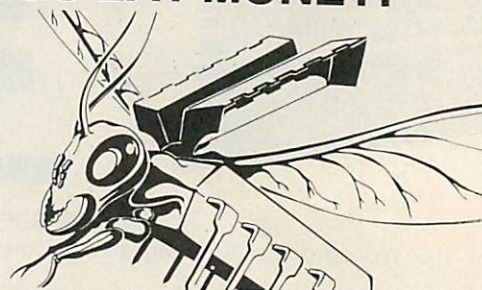
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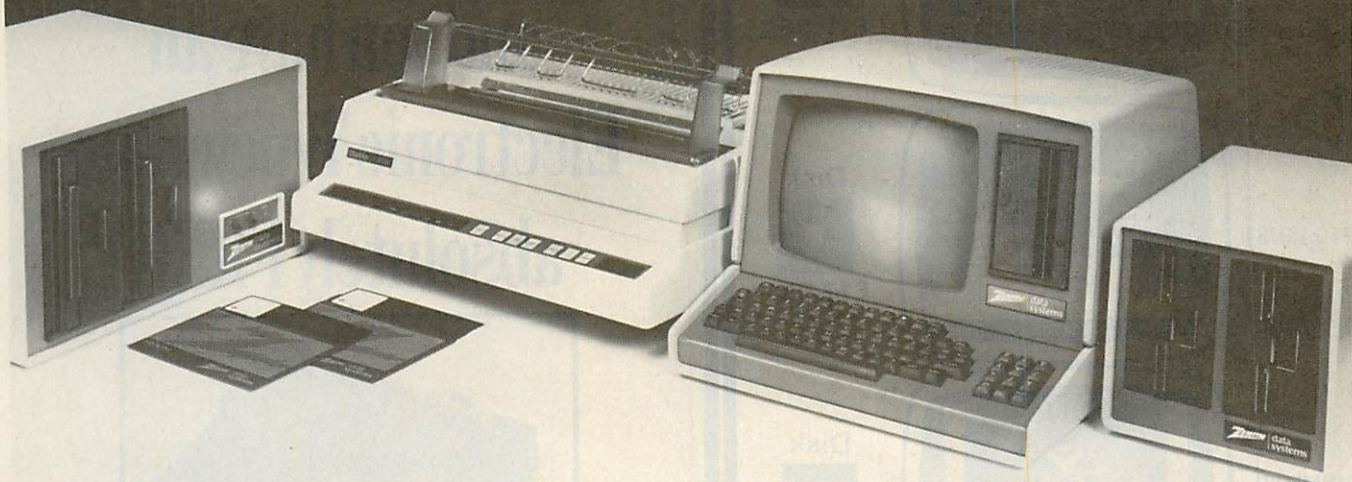
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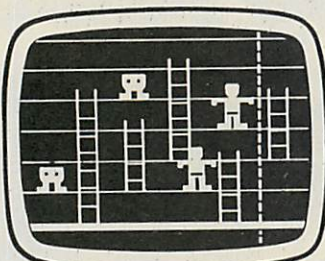
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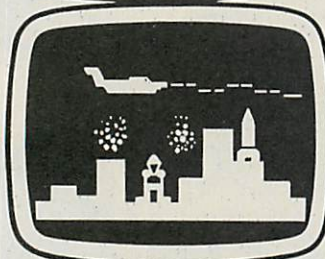
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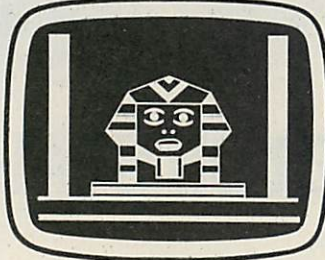
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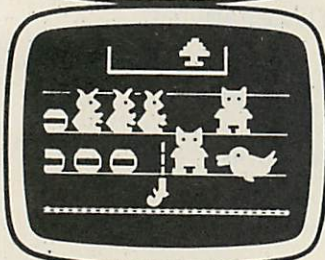
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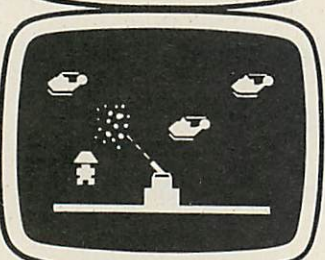
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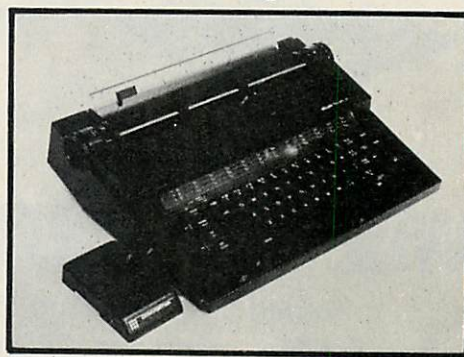
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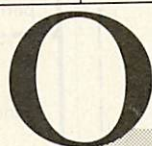
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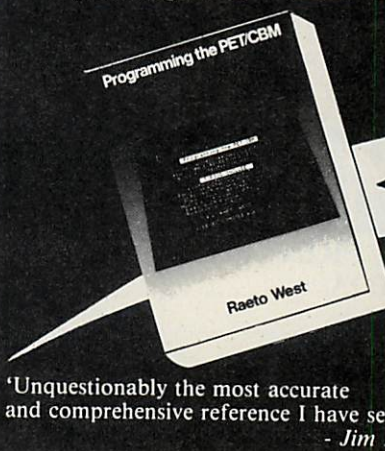
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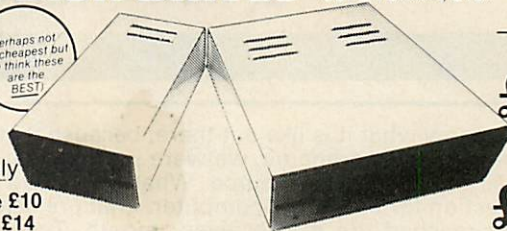
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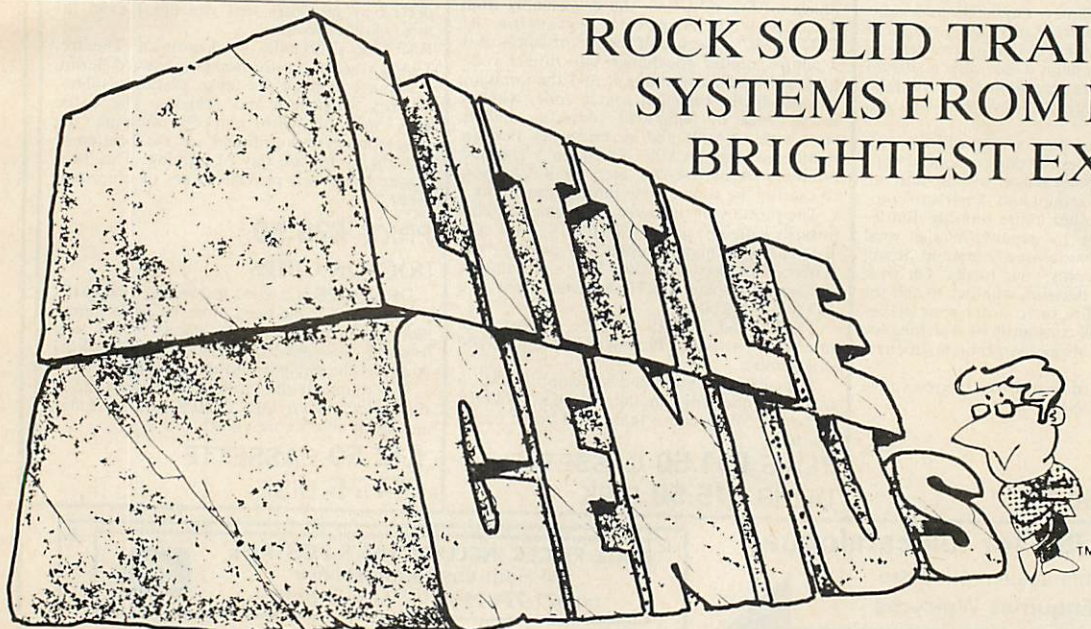
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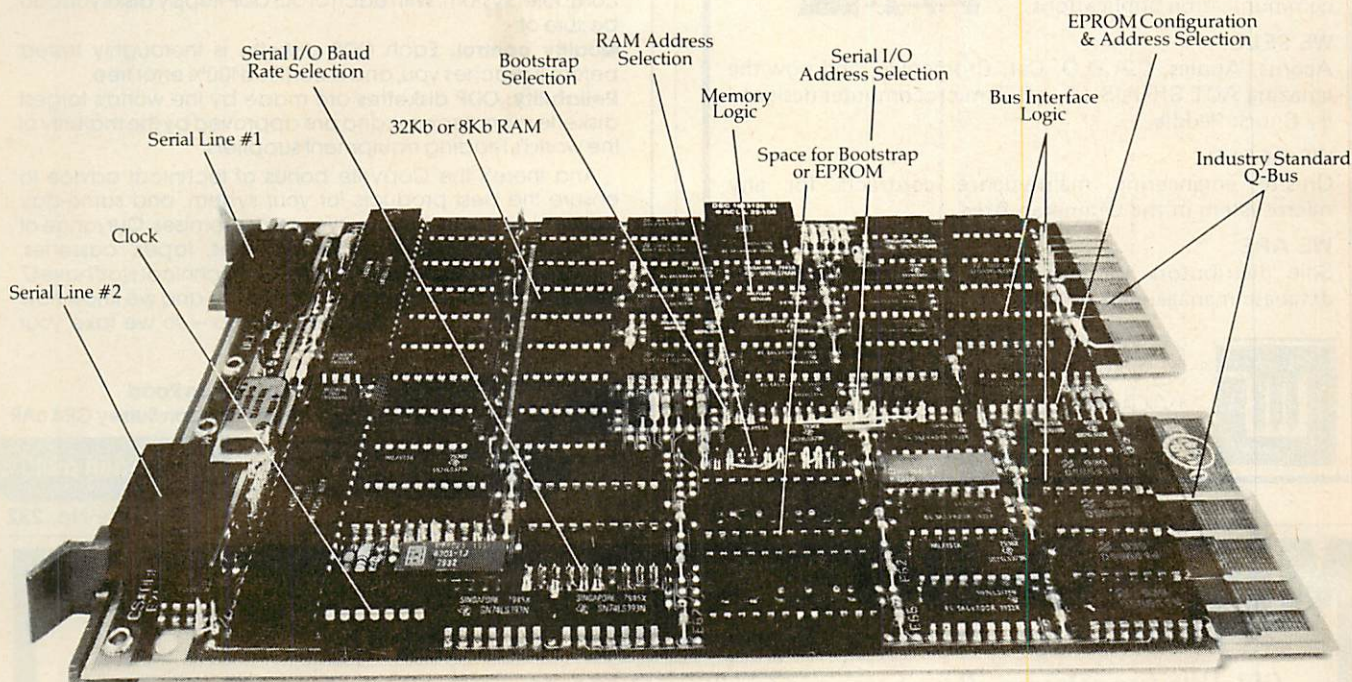
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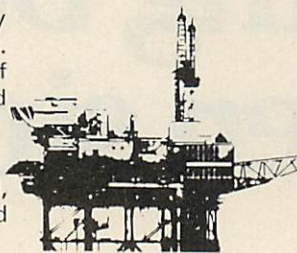
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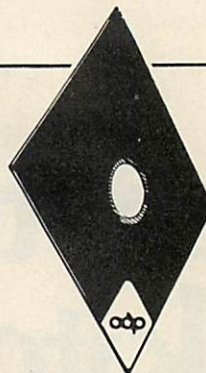
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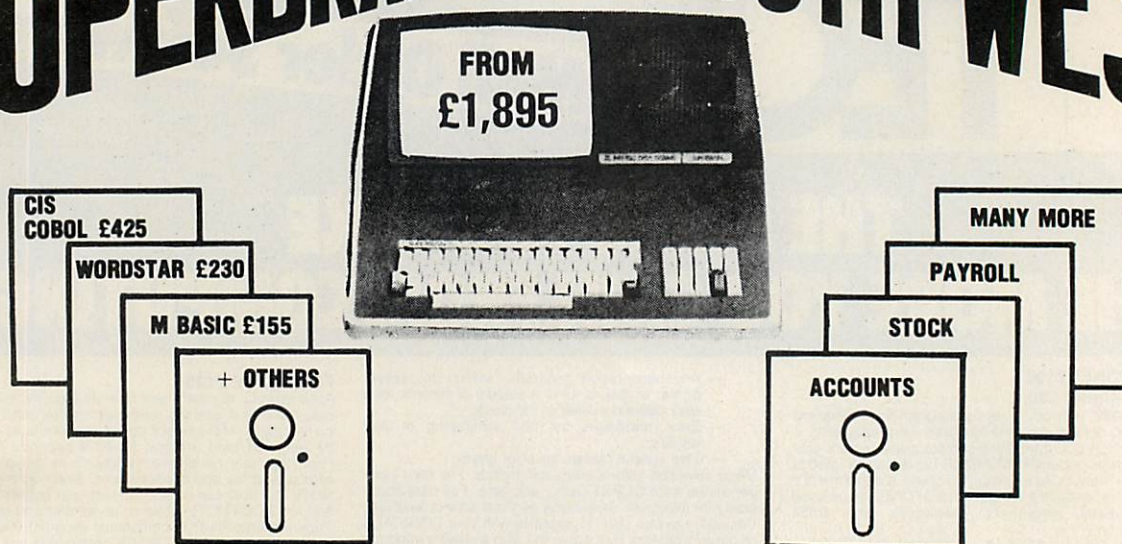
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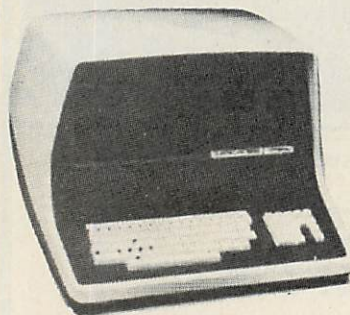
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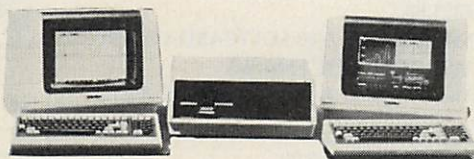
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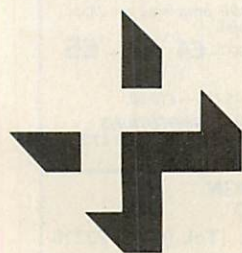
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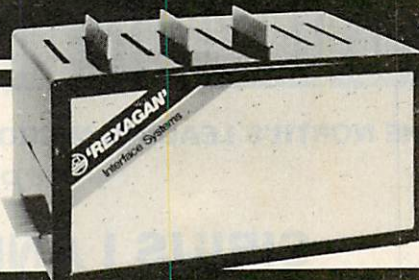
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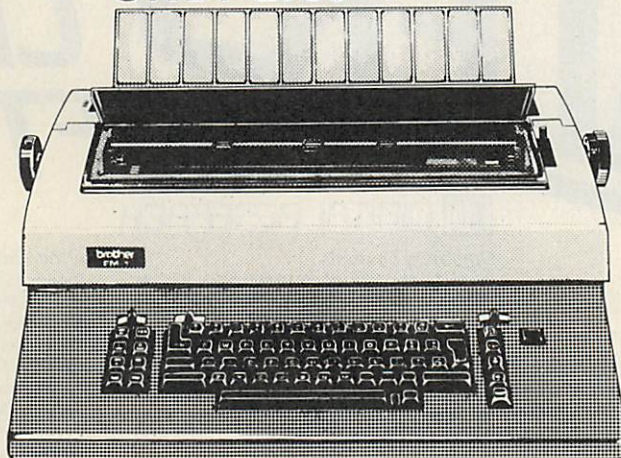
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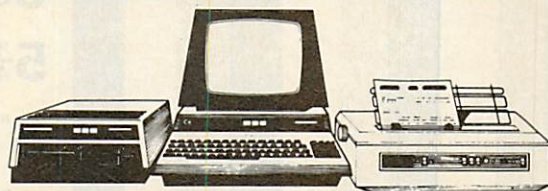
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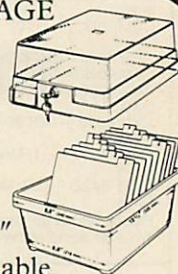
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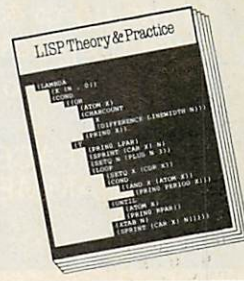
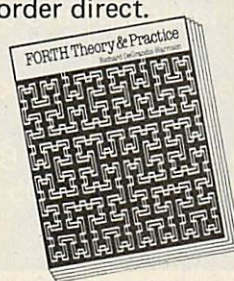
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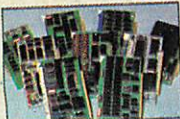
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